

A SYSTEMS THEORY APPROACH
TO THE STUDY OF PERSONALITY.

A thesis
submitted in fulfilment
of the requirements for the Degree
of
Doctor of Philosophy
in the
University of Canterbury
by
Robert Garth Ritchie.

University of Canterbury
1984

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Acknowledgements

Thanks are due to the many people who have provided support, encouragement, advice and their skills. Without this assistance, this thesis would not have been possible. I wish to thank Mr. P.N. Russell and Prof. K.T. Strongman of the University of Canterbury Psychology department for their valuable supervision. Having such affable supervisors has played a large part in insuring the completion of this project.

Thanks to my typist Mrs. A. Kirk, who has done so well with my scrawled manuscripts.

Thanks are also due to many fellow students who have provided a network of information and advice during the various stages of this thesis. I would like to make special mention of Richard Tan whose friendship, help and sporting prowess has made my work on this project not only bearable, but enjoyable.

Finally, I would like to mention my friends and flatmates who have been good to a cranky individual. My sincere thanks to them for ensuring that other areas of living were not totally overshadowed by this project.

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ABSTRACT

The literature on information processing approaches to emotion is surveyed. It is concluded that an approach that looks at the way in which the emotion system employs the cognitive system has merit.

In Chapter two Miller's (1978) criticism of abstract system theory is applied to personality theory. It is argued in the light of this criticism that psychologists should identify the cognitive microprocesses associated with emotion as the first step in a concrete theory of personality.

Chapters three, four, and five, detail a series of experiments towards identifying the microprocesses of emotion. Chapter three details how perceptual defence was found to decrease with increased levels of arousal. Chapter four details an investigation of the effects of emotion upon the semantic network. Some indication of subject differences in the processing of threat related material was obtained. In chapter five, experimental evidence of attention biasing towards affect congruent material is outlined. Momentary affect states seem to have a strong influence on attention.

A theory of emotions as problem solving heuristics is put forward in Chapter six. The theory is formulated in the terminology of Anderson's (1983) ACT model of cognitive skills. It is used to account for experimental and phenomenological data.

Lastly, the promise and limitations of the ACT model of emotion are noted in Chapter seven. It is concluded that research into the influence of emotion on information processing might be an essential component of a 'concrete' theory of personality.

Note to the Reader

The reader of this thesis will be assisted if they adopt the same meaning of the words affect, emotion and mood as has the author. As much as possible, throughout the thesis, these terms have been used interchangeably to indicate enduring emotional states. When momentary emotional states are considered, these are indicated by the use of the word momentary.

As well as the use of the three terms to label states of consciousness, they have also been used to label stimulus material. Again, the terms are used interchangeably. For instance both the term 'emotionally significant word' and the term 'affectively significant word' indicates a word that designates an object or an event highly associated with an emotional experience.

Chapter One: An introduction to approaches to the study of emotion from an information processing perspective.

This chapter deals with the psychological literature on emotion which is either in the form of an information processing account, or is material which should be accounted for within an information processing model. The aim is not to provide an exhaustive review of all the relevant literature, nor to provide a total synthesis of the theories and frameworks reviewed. Rather the aim is to highlight the issues of emotion research that a comprehensive information processing theory of emotion should incorporate, and to do so by discussing the manner in which extant theories and paradigms have succeeded or failed in addressing the problems in the field. The chapter ends with a recommendation for research goals, and a general framework for incorporating research. A chain of connecting issues is presented with no particular issue having paramount importance, although a clearly discernible subfield of memory research will be addressed in a unitary manner. (That is, the issues most central to human information storage and retrieval under emotion will be looked at successively).

It is perhaps obvious that emotions are not just phenomenological experiences, but are important determiners of the course of action. For Arnold (1960) the felt tendency toward or away from the object of emotion is critical to the phenomenology of emotion. Thus Arnold argues that following perception and appraisal, there is an action tendency that is felt as emotion. Such a tendency

should be manifest in the correlation between reported emotional experience and actual and desired behaviour. There have been various demonstrations of correlations between experimentally induced affect and behaviour. For example several studies (e.g. Barden, Garber, Duncan & Masters, 1981, Alderman 1972) have demonstrated an effect of mood state on the tendency of children to engage in helping behaviour. These mood states also affect learning and have been shown to produce emotion state dependent learning effects (e.g. Masters, Barden & Ford 1979). Such studies, taken together with everyday observational evidence that emotion and action covary would be convincing evidence to a naive observer that emotions are determiners of the course of action. However, the scientific observer should not confuse covariation with causality and so in the case of studies that are purported to establish the influence of emotional states on behaviour, it is important that observation of the emotional state can be established prior to extensive change in the behaviour being influenced. To ensure that such a temporality occurs, is to ensure that measures of emotionality are purely measures of emotional experience and are uncontaminated by inferences about what everyday emotions would be responsible for behaviour. Inferences based upon implicit theories of personality organisation have been shown to be very unreliable (Shweder, 1982) and implicit theories of emotion are unlikely to be better. Unfortunately, there is a great difficulty with approaches in psychology that seek to obtain pure 'unbiased' measures of cognitive and emotional states. The very act of attempting to obtain measurements of states unreferenced to the environment

responsible for the state induction, may be removing an essential component of the meaning of emotion. Thus, we may find ourselves in the position of attempting to build a psychology of real-world emotion, from laboratory findings based upon quasi-affective states. Consider for example four major methods of affect induction:

- (a) Drug induced arousal states and an appropriate situational context for emotion. (e.g. Schacter and Singer, 1962; Marshall & Zimbardo, 1979)
- (b) Mood induction by having subjects repeat self referent statements. (e.g. Velten 1968; Sherwood Schroeder, Abrami & Alden 1981; Natale & Bolan, 1980)
- (c) Mood induction by hypnosis (e.g. Bower 1981; Bower, Gilligan & Montero 1981; Bower, Monteiro & Gilligan 1978).
- (d) Emotional states produced by winning or losing in a game situation, or by an unexpected event (e.g. Isen 1978, Isen & Means, 1983; Boggiano & Hertel, 1983).

Of these methods, the first and the last require interactions within the emotion eliciting situation and will thus be partially contaminated by inference processes that operate on the situation. Even for (b) and (c), it is unlikely that the affective intensity obtained will be independent of the environmental parameters. For example, if the hypnotic induction is to produce anger, it is likely that the anger will be more intense, if the situational context is frustrating. Thus, the case of hypnotically induced emotion is possibly one in which the hypnosis acts by

triggering an emotionally significant behavioural sequence upon which an inference process acts resulting in the attribution of an emotional state. In short, while there is evidence that behaviour and reported emotional states are highly correlated, it is hard to establish that this is because of the influence of emotional states over behaviour. Indeed, when evidence is collected purely from the behavioural domain one can argue that any influences reported can just as readily be attributed to dissonance reduction (Festinger, 1957) as to the influence of emotional states. Such a position receives support from the work of Robinson (1981) who shows that prior cognitive contexts (in terms of evaluation judgements), can affect the rating of the emotionality of personal memories. Such a result is consistent with Robinson's conclusion that remembered affect does not consist of an unmediated report of affect memories, but that it can be more properly viewed as the product of judgement processes. While this conclusion is for judgements of the affective intensity of life experience memories, it does highlight the possibility that the internal physiological symptoms of different emotions are not readily discernible, and what is used to assess the intensity and direction of affect is cognitive construals based on situational inputs (cf Mandler, 1975).

The referencing of affective state to the inducing environment, is the subject of much research of the kind seen in emotion misattribution experiments. (e.g. Deinstbier 1979; Kelley and Michela, 1980; Liebhart, 1979 for reviews). While there is difficulty in replicating affects such as the selective quiescence paradigm (Valins & Ray, 1967), most

researchers conclude that the effects showing the situationally obtained misattribution of arousal are real. Nisbett and Wilson (1977) criticise much of this research on the grounds that verbal reports are very unreliable indicators of change. We argue here however, that the demonstration that judgements of emotional states are influenced by situational factors (mediated by cognitions), indicates that emotional states are inferred states, and are not immediately reportable. If this is the case, then the question of the relationship between emotional states, and behaviour is to be resolved by acknowledging that emotions are indefinable without reference to behaviour, and thus it is tautological to suggest that they are a cause of behaviour. This does not mean that emotional states are not important variables in the prediction of subsequent behaviour, merely that their status derives from socially defined (or conditioned) rules, and like implicit theories of personality, they cannot be assumed to have predictive utility.

Meta-Theory and Theory

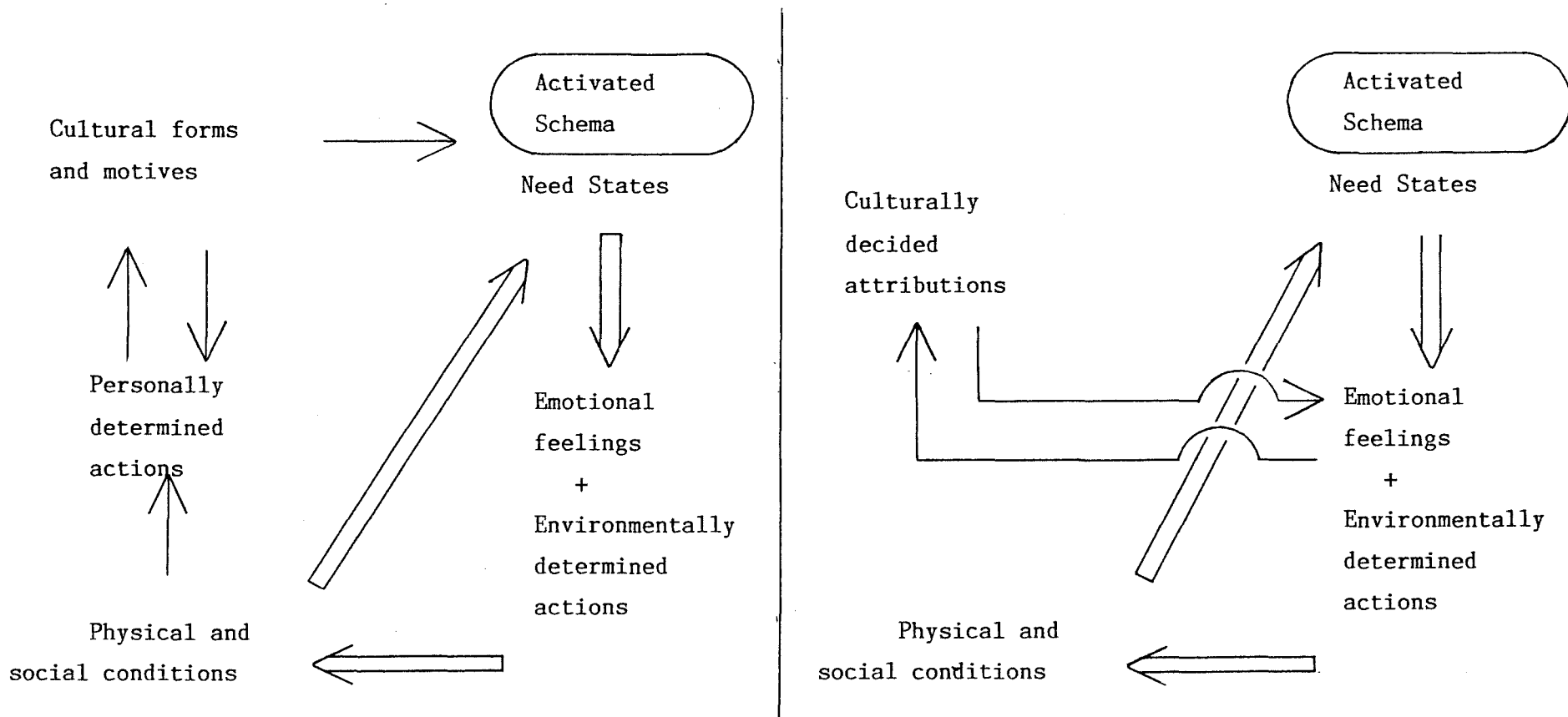
The possibility that emotions are not just innate physiological responses that occur to evolutionarily programmed situations is put forward in the most direct form in the constructivist theory of emotion of Averill (1980, 1983). Averill (1980) defines emotions as 'Transitory social roles (socially constituted syndromes) that are based on the individual's appraisal of the situation and that are interpreted as passions rather than as actions.' (Averill, 1980 p.312). The social-constructivist position advanced has it that meaning or structure is imposed on events, and

emotions are a particular class of social event construction. One of the most significant aspects about emotions for Averill, is that we classify the syndromes associated with emotion as passions rather than actions. Thus, emotions correspond more to a classification of subjective passivity than subjective control. This way of looking at emotions places the essential function of emotion at the social and not evolutionary-biological level. The theory then, directs us towards research which seeks to elucidate the patterns of social meaning that support emotional acts, rather than concentrate on the physiological processes that permit emotion. The theory thus acknowledges the three-way interaction between verbal responses, physiological arousal, and the experience of emotion put forward by Schacter and Singer (1962), but instead of concentrating on emotional plasticity it seeks to elucidate the social rules that support the emotional syndromes. It escapes the criticism that it is a theoretical framework from which 'reasons' are excluded in favour of analysis of variance corroborated 'causes'. In the terminology of Semin (1980) who devastatingly criticises the ideological status of attribution theory, the theory recognises the importance of the socio-logic of everyday life.

The distinction between theories that take as their starting point 'raw data', and theories that require a phenomenological analysis of causal attribution arises in the discussion of the last paragraph. This is an important meta-theoretical issue to be faced by emotion researchers. On the one hand, there is a tradition dating at least to Kant (1978) that makes purposes and reasons an integral part

of emotional acts, and on the other hand, there is an approach exemplified in Descartes that places emotion as arising outside of mind, but exerting influences on it. The Kantian approach is expressed in : "Passion always presupposes a maxim of the subject according to a purpose prescribed to him by the inclination. Consequently it is always connected with his practical reason, and passions cannot be ascribed to mere animals, any more than (they can be ascribed) to purely rational beings." (Kant (1978) p.266). The emphasis is on purpose and the ascription of reasons based on non coerced rules. These rules are absent in animals and so they do not share the complexes termed passions in humans. For the more mechanistic approach of Descartes however, the agitation of animal spirits that produces passions is a purely bodily function that only appears to occur in the mind. The two divergent approaches find their modern exemplars in the emotion attribution paradigms (Deinstbier, 1979), and the constructivist theory of emotion already outlined. The issue is not as trivial as whether cognitions are regarded as phenomena or epiphenomena: the methods of investigation, and the language of explanation are determined by which approach to the theory of emotion is adopted. A rationalistic approach will attempt to make reasons not just coincidental to emotional experience but also the distinguishing features of emotions. Also, following from this, the patterns of culture that furnish the reasons need to be studied and understood, since the cycle of causation is not static but arises from a historical context of need states, and their cultural solutions. Figure 1-1 contrasts the cycle of

FIGURE (1-1). CYCLES OF BEHAVIOUR CAUSATION CONSIDERED WITHIN
RATIONALISTIC AND MECHANISTIC THEORIES OF EMOTION.



(a) Rationalistic Theories of Emotion.

(b) Mechanistic Theories of Emotion.

causation in rationalistic theories of emotion with that of more mechanistic theories. The main difference between the two types of theory is that 1(a) includes cultural forms and motives in the cycle of emotion directed processing and behaviour whereas the mechanistic type of theory (1-1(b)), regards cultural forms and motives as being important only in the attribution of feeling (and consequently the direction for appropriate behaviour). Rationalistic theories view culture as being a necessary condition for emotion instigation, mechanistic theories will tend to view culture as unnecessary for the instigation of emotional experience, and necessary only for its categorisation. At least one major theorist in cross-cultural psychology (Binnie-Dawson 1982) provides a metatheory congruent with the rationalist position. The final choice of which metatheory will prove most useful will have to wait until the analysis of emotion becomes fine-grained enough to distinguish the predictive utility of the two approaches. Both metatheories provide a framework sufficient for the explanation of presently studied phenomena.

The Importance of Culture and Content

One problem that is highlighted in the discussion of which kind of meta-theory to adopt, is the likelihood that the range of human emotions is not fixed, and cannot be studied without reference to the content of emotions. Tuan (1979) points out that specific fears are often learned, and will differ from culture to culture. He points out that fear of external nature tends to decline as it is subdued, but civilisation does not reduce the malevolence

ascribed to human nature. Tuan reviews evidence of 'fearless' societies, and points out the specific cultures and environmental characteristics which produce such a relative paucity of fear in their members. Such evidence again highlights the difficulty in generalising the results of specific experiments across cultures: the paradigms that induce emotions, and demonstrate the influence of emotion on response or recall processes are not likely to be immune from cultural factors. This will be so in spite of the fact that the specific induction procedure used to produce the emotion is chosen to be efficacious within the culture of the induction group.

The culture will also be defining in the case of the appropriate response processes (which cannot be separated from the emotion complex). For instance Beigel (1951) traces the origins of romantic love and shows that it derives from courtly love but that it differed in that it transformed the ideal from that of love after marriage to that of love before marriage. Such socially prescribed behavioural mores are likely to be integral parts of the social schema, that allow the evaluation of social interaction processes. They are emotion defining (love versus lust), and emotion directing. The later point is made by Pope (1980) who traces the changing focus of romantic love from that of knowing, to that of union and finally today to participation in a shared life. These focuses determine the ideal action sequences and cognitive strivings between lovers and so will dictate the direction of romantic experience. For instance Pope uses as a prototype of the ideal notion of love for the early period, the relationship

between Odysseus and Penelope from the Iliad. He points out that on Odysseus's return, it is the process of reacquaintance in a 'knowing' sense that is pursued, and the fond embrace comes much later.

A final example of how it is impossible to divorce the study of emotion from the content of emotion is taken from Schoeck's (1970) theory of social behaviour mediated by envy. Schoeck points out that for feelings of envy to arise we have to experience a state of impotence with respect to the possession of the envied, and the envied has to be experienced as the cause of the failure to have the possession. Here, the view of the world will have an important influence on whether or not envy is experienced; some cultures attribute ill health to witchcraft by an envious party, and Schoeck argues that where equality is supposed to be the natural order of things, inequalities in an attribute will be prone to envy. Thus, culture and custom will determine what are possible cases for envy. If psychologists attempt to study an emotional state without its concomittant content, the danger is that they overlook specific culture-state linkages that make an emotional state unique to a culture. The psychology thus derived could be more one of description of common tendencies than the analysis of naturally occurring categories.

Schema Invariance Assumptions

The relationship between socially transmitted schema and emotional experience raises several issues about the kinds of information that such schema operate on, and the extent of schema uniformity across subjects. For example

a number of studies have investigated the relationship between expressive tendencies and emotional experience, and important differences in people have been obtained. The division of people into those that tend to facially express changes of emotion (expressors), and those that are facially non responsive (inhibitors) has been made (the terminology is that used by Notarius and Levenson (1979), although other labels have been used to characterise these different groups). The evidence supports the explanation that the two groups attend to different kinds of information during emotional episodes; expressors attend more to self produced cues; inhibitors tend to give precedence to situational cues. Consistent with this interpretation, Laird and Crosby (1974) found that expressors tend more than inhibitors to see emotion as closer to a sensation than a cognition. Laird, Wagener, Halal and Szegda (1982) show that only expressors show material expression congruity effects in a series of experiments on the effect of emotion on memory. These results cannot be interpreted simply as indicating that facial feedback is the critical source of emotional experience as some researchers would have it (e.g. Izard, 1977; Tomkins, 1962). This is because other research has indicated that inhibitors tend to be more autonomically liable to threat than expressors (Notarius and Levenson, 1979). Further, under some circumstances greater expressivity can be accompanied by a reduction in reported affect (e.g. Leventhal and Mace, 1970, Cupchik and Leventhal, 1974).

Yet other researchers have shown that manipulation of facial expressiveness is correlated with autonomic responses and subjective reports of emotional experience (e.g. Zuckerman, Klorman, Larrance & Spiegel, 1981). The important lesson is that results in the research literature on expressivity and emotion are not integrable unless the assumption of emotion schema invariance is dropped.

The fact that individual differences in the use of emotion cues are apparent and important, highlights that emotion researchers should be very cautious in drawing general conclusions from specific paradigms. It is of course desirable that psychologists should strive towards broad theories. The results discussed above point towards two serious sources of error for theories that are too tied to particular experimental procedures:

- a) There are acute dangers of lack of generality because subjects are not properly sampled. In information processing theory based research, the tendency is towards smaller samples of volunteer subjects, and it is quite possible that the typical method of obtaining volunteers produces an over representation of externalisers or internalisers in the sample. Notarius et.al. (1979) report that externalisers score significantly higher on an empathic tendency scale, and obviously if persons differ in terms of personality dimensions, preference for taking part in unexplained experiments is likely to be different.
- b) Small differences in experiments are likely to produce quite markedly different results. This is most dramatically demonstrated by the influence of an object in the experimental situation that biases subjects towards self focused attention.

Scheier & Carver (1977) showed that the presence of a mirror in the experimental setting made subjects more responsive to their transient affective states. Other studies have called into question some predictions (e.g. McDonald, Harris, & Maher, 1983) , but in view of the pervasiveness of self directed attention effects (e.g. Scheier and Carver 1981, Scheier and Carver 1982), it is more likely that such minor deviations just show the sensitivity of results to small paradigm shifts. Recently, Hoover, Wood and Knowles (1983) have demonstrated that a brief early interaction that induced self-focused attention had considerable influences on ongoing behaviour tendencies. This result indicates that even slight changes in subject briefing between experiments can conceivably have major effects on experiment outcomes.

Self Schema and Emotion

The discussion on the problems that arise because of individual differences, and within-subject differences implicates the importance of self schema for an understanding of emotion. Epstein (1979), has a theory which combines the self schema with the world view in development of affective responses. While Epstein does not provide direct evidence linking self schema and affect, his evidence for temporal stability of emotion Epstein,(1982), is consistent with a self schema component in affective processes. The utility of the kind of emotional profiles that are obtained from individual subjects, and whether they can be connected to a self structure will provide surer evidence of the theory (if obtained). Linville (1982) has reviewed several experiments which indicate that the ~~less~~ complex a persons

self-representation, the more extreme affective responses seem to be. This result mirrors earlier work by Linville (1982), in which it was established that evaluation of out-group members was more extreme the less complex the rater's schema for the outgroup was. Once again the self schema seems important to the study of affect. Linville's results relate to the intensity of affect. Other research has been done on the relationship between cognitive complexity and the range of affect. Sommers (1981) has found a positive relationship between emotional range and cognitive complexity in the description of persons. This raises the possibility that Linville's results are artifacts of using scales that do not encompass the full extent of evaluative reactions that a subject may experience. However, even if this last explanation is correct, there is no question that the extent of the self schema is implicated in affect patterns.

On the other hand, there are formulations which suggest that the relationship between self schema and affect, is not integral, but rather the interaction between two functionally distinct systems. Roger (1981) in reviewing his work on memory and reaction time to self referent statements' provides a two factor theory with the self prototype providing the analytic nodes which are amplified by emotional reactions. Further empirical evidence for the separateness of the self-schema and the emotion system is to be seen in a series of studies by Mueller, Heesacker, Ross, and Nicodemus (1983) which shows that for face recognition, encoding faces via decisions about similarity of target face to the face of the encoder, is inferior to encoding the face via decisions about emotional qualities. An experiment which

combined emotional quality decisions and self-referent judgement, failed to improve performance above that of self-referent judgements alone. This implies that for facial recognition, the activation of the self schema ensures an encoding and retrieval route independent of emotional content. (That conclusion applies only for pictorial material; for verbal material Mueller et.al. replicated the recall superiority of self-referentially encoded material found by Rogers, Kuiper and Kirker 1977).

The literature which relates affect induction to the self schema provides the link which could allow the integration of the apparently conflicting claims about emotion and self schema. Sherwood, Schroeder, Abriami and Alden (1981) predicted that in accord with Weiners (1974) attribution theory, self-referent statements would induce a higher level of experienced affect than would non-self-referent statements. This prediction was confirmed, suggesting that self-reference of material may enhance its ability to trigger affect. However, any differential memory effects are likely to result from two factors; firstly the extent to which the information may be processed by the existing cognitive schema; secondly the degree to which emotion schema are called into play by the relevance of the information to salient aspects of the self-schema. Thus, it is understandable that individual differences (Linville, 1982) in the extent of the self-schema are correlated with recall by the first mechanism mentioned above. The second mechanism can explain the lack of a superiority in self referred face recognition over attribute referred face recognition (Mueller et.al., 1983) if we regard personal facial feature attributes as not being an integral

part of the self schema. Lord (1980) has reviewed evidence that suggests the distinction between self-schema and self-image, and the face recognition results relate to the latter. Finally, the study by Sherwood et.al. (1981), and another study by Riskind, Rholes and Eggers (1982) confirm the importance of the self-schema in moderating affect. But as well, these two studies demonstrate that it is not just that material needs to be in the same content area as the self-schema for affect to occur; the material needs also to be related to the self schema. This is consistent with the two principles by which we have explained the results of this section.

Detachment of cognitions and Emotion

A major issue that emerges out of the previous section on emotion and the self schema, and an earlier section questioning the causality of emotions is the extent that emotional processes can be viewed as separate from the attendant cognitions. Zajonc (1980, 1984), for example suggests that affect and cognition are under the control of separate and partially independent systems, and that the output from the affective subsystem precedes that of the cognitive subsystem. Lazarus (1982, 1984) takes issue with Zajonc over whether it is possible to have affect without a cognitive encoding. He concludes that Zajonc's conclusion about the partial separability of the affective and cognitive subsystems is based on the incorrect assumption that cognitive processing occurs through sequential stages. Since this is a dated version of cognitive processing, he argues that Zajonc's results of affective judgements capable of

being made before other judgements does not indicate anything more than a judgement made via a partial cognitive encoding. Leventhal (1980, 1982) takes a middle position between those put forward by Zajonc and Lazarus. While acknowledging that some components of the emotion experience are handled by a subsystem devoted exclusively to emotion, he argues that two other processing levels are also called into play. Firstly, he postulates emotional schema which integrate the perceptual codes of emotional experience and form an emotional memory. Secondly, Leventhal has a conceptual component in the interactions defining emotion, which operates by attributing causes to typical emotional episodes and also by following emotional scripts which can regulate emotional life. These two processing levels (schematic and conceptual), interact with the more fundamental level of expressive-motor behaviour to produce emotional experience.

It is clear that while the above three theories seem to be making widely disparate claims, they have certain elements in common. None denies the fact that there are cognitions and judgement processes attendant to emotional experience, and therefore comprising part of the experience. Nor do any of the theories question that emotional experience can be relegated to 'nothing but' cognition. The real issues seem to be those of degree and not of kind.

Explicitly -

- a) To what extent a cognitive involvement is necessary for emotional experience?
- b) To what extent does the analysis of an aspect of emotional experience (e.g. schematic, conceptual) require reference to other aspects

of emotional experience for the development of
a psychology of emotion?

Issue a) separates Lazarus who suggests that cognitive mediation is always a necessary condition for emotion from Zajonc whose experiments purport to demonstrate that affective significance can arise prior to knowing. Issue b), is one which will determine at which level our scientific efforts are pitched. For Leventhal, it is necessary to incorporate considerations of all three components of emotional experience in order to understand emotion in everyday life. For example Leventhal (1982) recounts an example of a cancer patient who gained joy from the act of being capable of obtaining a glass of water. This example does require an understanding of schematic and conceptual levels to appear sensible. But, to a large extent issue b) is also a non issue because as becomes evident from considering other fields of science such as general systems theory (e.g. Miller, 1978) has done, it is necessary to study both at the level of the organism as a concrete system, and also at the level of the subsystems that are components of the system. The polemic that arises because of issue b) (theorists differing in their levels of analysis), is unjustified.

There is one area though, where the detachment of cognition from emotions has been specifically researched. This is the area of anxiety; specifically-test anxiety. Liebert and Morris (1967) put forward a conceptualisation which divides anxiety into the components of worry (the cognitive element) and emotionality (the physiological element). In a recent review (Morris, Davis and Hutchings 1981), it was concluded that the two components are probably

maintained by different aspects of stressful situations. They concluded that worry may or may not accompany the emotional component. Other researchers question whether test anxiety is best conceptualised in terms of the two component theory. For instance the review by Morris et.al. notes that there is much evidence that worry may be reduced without a reduction in the emotionality component. Finger and Galassi (1977) provide evidence that interventions that should act exclusively on one or other component, tend to act on both, and that performance measures were unaffected by changes in the scores of the components. Thus the question remains of whether the cognitive component (worry) is requisite, or whether it is just an undesirable accompanying phenomena to the emotional state. The position that seems most likely is that meanings given to the test situation are necessary conditions for the experience of test anxiety (e.g. Weiner 1982). However, once a pattern of affective responses to test situations is established, cognitive evaluations need no longer be consciously processed. Restating this a little differently - the interplay between affective states and cognition must be acknowledged, and the question of whether overlearned affective responses retain a cognitive component should be bypassed. (Until psychologists are prepared to distinguish clearly between cognitive structures and cognitive acts.)

Arousal

(a) Arousal as a Theoretical Construct

Closely akin to the question of whether cognitions are detachable from emotions, is that of the role of arousal in emotional processes. The two factor theory of emotion

best exemplified by Schachter and Singer (1962) or Mandler (1975) has arousal as one of the factors of emotion, the other factor is cognitive, involving assessment of the situation for explanation of the arousal. Two factor theories such as these assume that cognitions are essential to emotion. They are *conditio sine qua non* for emotion. Such theories in general, do not concentrate on the details of the processing that underlies the cognitive evaluations but tend to concentrate on attribution paradigms e.g. (Kelley and Michela, 1980; Zillman, 1978). Plausible processing mechanisms are often put forward (e.g. Mandler 1975), but to date the specifics of the cognitive processes have not been investigated. Instead, two factor theorists have tended to concentrate on trying to understand the conjunctive rules that tie together situations, arousal and behaviour/experience.

Some typical examples of the social psychology experiments that take their germ from the two factor theory are now detailed. Dutton and Aron (1974) showed how the implications of two factor theory are confirmed in the area of interpersonal attraction. They showed that male subjects produced more sexual imagery to TAT stories when they approached attractive females on high bridges, as compared with low bridges. The same effect did not occur with males as the stimulus person. The result is completely in accord with the predictions of two factor theory; the results indicate that the extra fear associated arousal from a higher bridge, is attributed to the stimulus person, and this produces the higher level of attractiveness rating, and sexual imagery.

Another study that operates within a two factor framework is that undertaken by Gibbons and Wright (1981). They showed that high sex guilt subjects when confronted with an erotic stimulus, chose to attribute the arousal to a bogus source (non existent drug effects). Interestingly, in spite of the greater attribution of arousal to placebo effects, the high sex guilt subjects showed no corresponding reduction in sexual arousal. Gibbons and Wright attribute this last result in terms of two factor theory. They suggest that in spite of different causal attributions for their arousal, subjects did not assign a different emotional label to it.

Finally, Clark (1982) has conducted research that calls into question the explanation of experiments investigating two factor theory. She induced arousal in subjects through exercise and later had subjects rate their courses either after positive feedback, or neutral feedback. The results which she obtained showed that subjects in the high arousal, positive feedback condition rated their courses more positively than subjects in any of the other conditions. This result is not entirely encompassed by two factor theory, which does not predict that arousal can lead to access to more affectively toned memories. Thus, the two factor theory would assume that subjects in the high-arousal positive condition, would misattribute the arousal to the positive feedback, and that they would be no more inclined to rate the courses as positive than any other group.

Clark's challenge to two factor theory, highlights the difficulty that psychology has in differentiating between plausible (and predictive) mechanisms, and actual mechanisms. Clark, Milberg and Ross (1983), present additional evidence

that arousal acts as a cue for arousal related material in memory. This suggestion has considerable implication for the utility of two factor theory as an explanative theory. The results mentioned earlier of Dutton and Aron, could entail mediating memories that link fear and sexuality. Certainly, changes in arousal are likely to be coincidental with the heights of the bridges that subjects crossed, but this in itself is not an argument for the validity of two factor theory. Without a more extensive study of these classical experiments it can only be said that this account is plausible. Equally plausible is the proposition that any emotional state will have ongoing consequences for subsequent emotional states. The fact that arousal accompanies each emotional state does not ensure that it is the carrier of the influence of one state on another. Besides some researchers (e.g. Marshall & Zimbardo, 1979; Maslach, 1979) have suggested that unexplained arousal biases subjects towards negative affective states.

(b) Arousal Influences on Information Processing

Aside from the issue of whether arousal states are explanatory in the psychology of emotion, there is the question of what consequences arousal has for human information processing. The question is important because arousal has been posited as an accompanier of most emotions and understanding of arousal-information processing interactions thus forms part of the understanding of the total consequences of emotion.

There are numerous way in which arousal might affect information processing. Already the work of Clark et.al.

(1983) indicating that arousal does have an effect on the accessibility of arousal related material in memory, has been noted. Another way in which arousal effects have been shown to influence cognitive processes is the relative strength of short term memory and long term memory. Eysenck (1977) reviews the effects that arousal has on the recall of to-be-remembered lists. Considerable data comparing the recall of emotional/arousing material with neutral material, are explainable in terms of action decrement theory (Walker 1958). The theory suggests that higher levels of arousal make for greater trace consolidation which results in better long term recall for list items, but worse short term recall. Several different procedures have been used, and they have come up with results that are broadly interpretable in terms of action decrement theory. For instance, Kleinsmith and Kaplan (1963) had subjects listen to lists of paired associates, and they recorded skin resistance to index the level of arousal associated with to-be-recalled items. Berlyne, Borsa, Craw, Gelman & Mandell (1965), Berlyne, Borsa, Hamacher & Koenig (1966) used a different procedure which associated arousal with items by bursts of white noise. Other experimenters using paired association have had subjects associate to either neutral or emotional words (e.g. Levinger & Clark, 1961; Parkin, Lewinsohn & Folkard, 1982).

There has been quite an impressive measure of support for action decrement theory as a predictor of effects, but Eysenck (1982) suggests that there are enough unpredicted effects to warrant alternative hypotheses about the relationship between arousal and memory. He suggests that noise induced

arousal may act by reducing contextual encoding, and biasing against a semantic encoding of material. The explanation is plausible but it tends to downplay explanations in terms of arousal in favour of explanations in terms of the effects that noise has on processing. New explanations might not just be necessary for experiments dealing with noise induced arousal and memory, but might also be needed for experiments where arousal is manipulated in other ways. Even results which are in accord with Walkers hypothesis might need reexamination. For example, Kennan, MacWhinney and Mayhew (1977) found that high interactional content sentences in natural conversation are better remembered than low interactional content sentences. Subsequent investigation by MacWhinney, Keenan and Reinke (1982) revealed that such sentences were more arousing than low interaction sentences, but that there was very little relationship between arousal and memory. It is therefore concluded by them that factors other than arousal underlie their original results. Another way that arousal affects information processing, is through attention processes. Easterbrook (1959), has suggested that high arousal produces a restricted range of cue utilization. That is usually taken to mean that the aroused system devotes a higher proportion of its resources to the intake of information from dominant sources, and less to intake from relatively minor ones. There is much evidence that supports this hypothesis. For example the presence of white noise concurrently with to-be-learned words resulted in an improvement in ordered recall, and a decreased ability to recall incidental details such as word space location (Hockey & Hamilton, 1970). Andersen and Revelle (1982) predicted that high arousal would reduce

sensitivity to interword proof reading errors (which require a broad range of cue utilisation), but that sensitivity to intraword errors (requiring only a minimal range of cue utilisation) would be unaffected. Their results were consistent with predictions and the Easterbrooke hypothesis.

Eysenck (1982) has suggested that the Easterbrooke hypothesis be embellished to avoid the 'Easterbrook paradox'; '....Since subjects attend more and more exclusively to task cues as arousal increases, it follows necessarily that the more intense white noise becomes, the less it is attended to.' (Eysenck, 1982, p.167). To get around this paradox, Eysenck suggests that as well as increasing attentional selectivity, noise reduces attentional capacity. This reduction in attentional capacity places demands on subjects for a voluntary reallocation of attentional resources, and for the adoption of new strategies which involve a more restricted monitoring of the environment. Eysenck argues that the introduction of an arousing stimulus will affect two arousal systems; a passive arousal system that at high levels of arousal operates in accord with the Easterbrooke hypothesis; an active cognitive control system that operates 'effortly' and so can compensate for suboptimal levels of the first arousal system. Eysenck's is one solution to the finding that the effects of arousal on performance have not been integrated to the point where a one factor model can account for the effects of arousal. (Not even when restricted to only the data of noise induced arousal).

There have been other efforts, and within the literature of the effects of noise on performance, Poulton (1977, 1978,

1979), Broadbent (1978), and Hockey (1979), stand out. One of these, Broadbent puts forward a theory much akin to that of Eysenck's, and another, Hockey has put forward a theory that identifies the specific processing components that noise facilitates or debilitates. The approach taken by Poulton on the other hand, emphasises the effect that noise has on the stimulus. He assumes that arousal increases always affect performance positively, but that these performance effects are counteracted by the acoustic masking. The approach taken by Poulton is an exemplar of attempts to understand performance effects in experiments where arousal is the variable of interest, in terms of nonequivalence of stimulus conditions. The approach if correct threatens to reduce the corpus of knowledge about the processing influences of arousal to a corpus of artifact. If correct, then the results of the arousal literature should be carefully separated from the results of the emotion literature, because of the divergence in the paradigms that attempt to study the respective influences on processing. This is an important question for emotion theorists.

Finally, there is at issue whether arousal should be regarded as a unitary phenomenon, or having multiple components. Royce and Diamond (1980) suggest that the classic relationship between arousal and performance (the Yerkes-Dodson Law (1908)), is curvilinear because of the operation of two arousal systems. They suggest that reticular arousal is associated with an ascending curve (greater arousal better performance) and that limbic arousal is associated with a decending performance curve (greater arousal poorer performance). Eysenck (1982) has also followed

the possibility of two arousal systems, but whereas Royce and Diamond identify the characteristic of the second system as emotional, Eysenck identifies the second system as effortful. Thus there is complete disagreement between the theories as to whether a high arousal level of the second system will lead to performance decrements or improvements. Not only does this provide problems in interpretation of Yerkes-Dodson functions, but the implications for emotion theory are immense. If it is necessary to posit more than one functional arousal system, which is the system that operates during emotional activity (if indeed any system need be operating (cf. Linton and Hirt, 1979)). The need to answer this question is evident when we consider results such as those reviewed by Gilbert (1979) on the emotion reducing effects of nicotine. In general nicotine increases physiological arousal and yet decreases emotionality. Gilbert puts forward several possible explanations for the result including the possibility that this provides support for the two arousal system model of Routtenberg (1968). Certainly, such results are inconsistent with the simple arousal model that most emotion attribution theorists derive their predictions from. Since other research (e.g. Williams (1980)) has found evidence that nicotine strength can produce the classic inverted U shaped performance function, researchers should be required to tie their predictions to a theory of the stimulus conditions necessary to elicit arousal. As this research shows, and the call for two arousal theories shows, arousal is not just an increase in heart rate. Perhaps it is time to inspect the psychological significance of the classical

arousal manipulations in two factor theory paradigms.

Attention

The effect of emotion on attention processes is an area of research that is only just beginning to be explored. The previous section noted the work which had been done on the relationship between arousal and attention, here the question is broadened to what we know about the relationships between affect and attention (and vice versa). Hamilton (1980) has suggested a relationship between affect and attention that has it that positive mood is characterised by a close match between the actual information available to a person, and the optimal information level of that person. The optimal information level of a person is approached by means of what Hamilton refers to as attention regulators. These attention regulators (A.R.) augment or reduce aspects of environmental or internal information. Without a close match between external information, and the information capacity of a person, processing may be too effortful, or be uninteresting. This theory concentrates on the influence of attention on mood, although Hamilton acknowledges the reciprocal effect of mood on attention.

Another theorist (Klinger, 1982) emphasises the relationship between affect and attentional processes. In doing so, he does not state explicitly a controlling influence of emotion over ^{attention} (indeed he discusses controlling emotion via attention training). Emotion and attention are both characterised by being operational within the field of 'current concerns'. Current concerns are ongoing concerns that remain psychologically alive and reflect

underlying behavioural and physiological goals of the organism. Klinger argues that the evolution of a capacity for current concerns has been accompanied by the evolution of affective responses that reflect the direction of progress towards the goal. The relation between attention and emotion, is that they are both components of a behavioural response pattern designed to ensure that goal striving succeeds. Attention processes permit the detection of information related to concerns, and emotion is an evaluative response which permits the tagging of action and event sequences with evaluative significance.

What both theories emphasise, is that there are functional advantages to be gained by a linkage between emotion systems and attention allocating systems. There is however a paucity of specific research that demonstrates the linkage between the two systems. What evidence is cited tends to be evidence showing that emotionally significant stimuli are processed differently to emotionally neutral stimuli. Hamilton for instance refers to the work on perceptual defense begun with Bruner and Postman (1947), and McGinnies (1949). Klinger refers to the work of Corteen and Wood (1972) in which skin responses changed to words that had been previously shocked and were fed into a supposedly unattended channel. Both theorists in putting forward their plausible theories have not provided experimental evidence that the actual process of emotion can alter attention allocation. The closest to such a demonstration is the work of Hoelscher, Klinger and Barta (1981), and Klinger, Barta, and Maxeiner (1980) which show that dream and thought contents are influenced by current concerns.

There is some other more recent evidence that the emotional content of information has consequences for its processing (e.g. Nielsen and Sarason 1981; Bargh 1982), but still the emphasis is on the content of the stimulus material rather than on the emotional state of the subject influencing processing. Perhaps the closest to demonstrating an effect of affective state on attention is an experiment by Erdelyi (1973) in which Jewish subjects showed a deficit in recall of presented items, which there was a subliminal swastika at the centre of the presentation field. It can be argued in accord with Zajonc (1980), that this situation produced rapid affective reaction, and this reaction has consequences for the encoding of the other information in the display. However until research is done that manipulates emotional states and examines attentional consequences the specific interaction between emotions and attentional processes will not be fully understood.

Process Analysis or Separate System?

So far, the question of whether it is possible to reduce emotional experience to cognitions plus arousal, and the question of whether cognitive components are separate from affective components have been looked at. The issue addressed now is whether it is best to view emotion within the processing framework which has proved useful in other areas (see for instance the work of Sternberg (1983), or do we attempt to characterise emotion as a consequence of a separate processing structure. Unfortunately this question has been considered at the level of metatheory rather than theory. Take for instance the controversy over whether

affect precedes cognition (Zajonc, 1980 and Lazarus, 1982). Here, as outlined before, Lazarus takes issue with Zajonc's outdated metatheory of sequential processing and argues that his results when the sequentiality constraint is dropped, do in fact indicate that cognition is necessary for affect. But if Sternberg (1983) is right then metatheories are not falsifiable but furnish the constructs that are a language or formalism for theory. Ultimately, choices between metatheories must be made on the basis of their plausibility, completeness, specificity, generality and parsimony. Bringing Sternberg's insights to bear on the question of whether emotional processes are just reorganisations of continuing somatic, perceptual and cognitive processes, or are a consequence of a separately acting system; the critical issue is one of whether the extant cognitive process metatheories make the data of emotion researchers more comprehensible, or whether an additional framework need be called in.

As an example of the way in which the lack of an agreed metatheoretical framework can hamper research, consider the recent developments of research on the lateralisation of emotion. Campbell (1982) reviews the research and admits that "...we lack a coherent framework in which the processes involved in interpreting and displaying emotion are consensually defined and in which patterns of laterality are fully understood." (p.95). The lack of a coherent framework is evidenced throughout the research on the effects of emotion state or content on laterality. For instance Campbell in discussing the case of a brain damaged patient who could recognise and identify unfamiliar faces by

their expressions suggests that this result is not predicted by Zajonc's (1980) proposal that affect may be processed prior to identification and independently of it. Campbell's claim is only true for a sequential processing meta theoretical framework, certainly not true for a parallel processing framework.

Graves, Landis, and Goodglass (1981), in a study relating the ability to recognise words to laterality, conclude that if left visual field performance differs quantitatively from the right visual field performance, then there is evidence of two or more distinct processing systems (one in each hemisphere). This reasoning contrasts with that of Campbell (1982), who concludes that hemispheric differences in emotional sensitivity or expression seem to relate to hemispheric differences in cognitive processing. Safer (1981), also suggests that hemispheric differences result from differential access to (cognitive) codes for emotion; the left hemisphere specialising in verbal codes; the right hemisphere specialising in imagery codes. Leventhal (1980, 1982) takes the evidence for hemisphere lateralisation as supporting his idea of schematic-emotional mechanism. Even though such a mechanism would be part of the cognitive system, its autonomous nature as a separate processing structure is emphasised.

All in all, the interpretation of lateralisation experiments has met severe difficulties when the question of whether there is a discrete system for processing emotion is approached. To some extent this is because lateralisation experiments result in very general measures of localisation, and these on their own are insufficient to answer questions

about functional autonomy/seperation. (This problem is also considered in the next chapter where the distinction between abstract and concrete systems is discussed.) But the most significant difficulty is that the analysis of the consequences of emotion in terms of the existing componential cognitive meta-theories, does not answer the question of whether the meta theory could be substituted by a more extensive meta theory. The distinctions between

- (a) Emotion encoding
- (b) Emotion codes
- (c) Emotion(al) encoding processes

are not readily made within a purely cognitive meta theory.

Consider some examples from contemporary cognitive psychology research. Posner & Snyder (1975) have produced evidence that congruent emotional tone facilitates adjective matching times. Posner (1978) concludes that this indicates that there are two memory structures or codes involved in impression formation. This result and conclusion has been supported by research by Strongman (1982, Note 1) who has demonstrated that target words within emotional sentence frames benefit at recall compared with the same targets presented in neutral frames. Working within the framework of cognitive metatheory, these results are indeed interpretable in terms of specific emotion codes as an adjunct to the other codes associated with an item. However, the two storage model is such that it cannot distinguish between emotion codes as a facet of ordinary human information processing, or whether these emotion codes emerge because of a system adjunctive to the cold cognitions system. Certainly, the cognitive psychology meta-theory lends itself

to the identification of a separate store for emotion, but it can be argued that similar stores can be found for any semantically encoded attribute. The dual storage model could just be a consequence of the same processes posited for 'cold cognitions'. The problem is that phenomenologically there is good evidence that states of emotion are different from states of minimal emotionality (Leventhal 1980), yet the ability of a cognitive information processing metatheory to account for this is limited. Much of the problem lies with the limitation of an information processing metatheory; the limitation that has been pointed out by Fodor (1981) is that modern cognitive science's de facto choice of procedural semantics as a theory of semantics is plainly an inadequate theory at this stage. Different stores, different processing pathways (in the sense of different levels of elaboration, decision processes etc), still leave the problem of how the real world relates to the encoded representation that processes operate on.

Lest the reader wonder where the questioning of cognitive metatheory leads apart from the abandoning of the most scientifically acceptable way of studying mental processes, the endeavour will be concluded now. The previous discussion has not been to dissuade researchers from approaching the field of emotion through information processing methodologies. But rather the previous argument has been against reducing the data of emotion to being just the result of the encoding afforded information in the cognitive subsystem.

To be a useful theory of emotion (even if the theory remains predominantly cognitively rooted), the theory must

not deal with isolated cognitive processes and structures, but must deal with the total nexus of emotional influences on information processing. Fodor, 1981b), in considering the functionalist approach to mental processes illustrates the approach with reference to a soft drink vending machine; the danger commented on here, is akin to that which arises if we only observe the coin rejecting ability of a machine, without also taking in the drink vending component. A true understanding of the designers intent and structure can be gained only by coordinating the observations from the various 'windows' of measurement. In the case of emotion-cognition interactions, a wide data-base of observations of the influence of emotion on the component processes needs to be integrated before useful advances in theory will be made. In short, characterising emotion in terms of cognitive processes and structures, is not the same thing as explaining the influence of emotion on cognitive processes and structures.

Much of the material reviewed in this chapter characterises emotion. For example in one influential theory emotions are characterised by nodes in semantic memory (Bower, 1981). Thus, on this score emotion acts no differently to any other concept with a node in semantic memory and it will enhance the activations of related events and concepts. Recently Bower and Cohen (1982) have acknowledged the incompleteness of the network theory of emotion. They note that the theory leaves unanalysed how emotions are aroused in the first place. Their blackboard model with its emotional interpretation rules is a major advance, and the incorporation of goals (that direct processing in the system) is a step towards explaining the

influence of emotion on cognitive processes. Unfortunately most of the researchers in the field are still operating the old way and have not yet confronted the limitations of their theoretical/metatheoretical frameworks. Accordingly for most of the remaining discussion particularly in the area of emotion and memory, data will be emphasised in preference to theory.

Emotion and Memory Data

(a) Congruity of presented material with current mood at encoding:

Several investigators have demonstrated that where material is presented after an affect induction, later recall is influenced by the mood at encoding. Research indicating an encoding effect includes Nasby and Yando (1982), Bower, Gilligan and Monteiro (1981), Breslow, Kocsis and Belkin (1981), Jsen, Shalker, Clark and Karp (1978). Other research has found that facial cues produce significantly better recall to cue consistent information. (Laird, Wagener, Halal, & Szegda, 1982). At least one pair of researchers has attempted to differentiate between encoding mood induced response bias and discriminative ability (Natale and Hantas (1982)). They found that mood affects both discriminative ability (lower discriminability of positive material when depressed), and also response bias (subjects show less bias against the recall of negative self descriptions when they are depressed).

(b) Congruency between recalled material and retrieval mood:

Most researchers have failed to obtain an effect of

retrieval mood upon the extent to which congruent material (recently learned) is recalled. For instance Bower et.al (1981) showed that inducing mood during recall produced no selective recall of happy vs sad incidents. One notable exception to this pattern of no effect with recently learned material is a study by Teasdale and Russell (1983), who did find significantly better recall of retrieval mood congruent words.

Another exception to the lack of influence of recall mood on recall, is where the recalled material is personal experiences. Teasdale and Fogarty (1979) demonstrated that when subjects were depressed, the time to retrieve pleasant memories relative to unpleasant memories took significantly longer as compared with the time for happy subjects. Teasdale, Taylor and Fogarty (1980) extended this research by employing a design that had the same subjects experience each mood state. Again, the previous findings were confirmed, and it was found that extremely unhappy memories were far more likely to be retrieved in a depressed mood than in an elated mood. These results are not just a consequence of affect induction since similar results were obtained from patients using naturally occurring diurnal variation in depression as the affect manipulation (Clark and Teasdale 1982). Other studies showing that current mood affects retrieval of life experiences includes that of Natale et.al. (discussed in section (a)), Madigan and Bollenbach (1982), and Synder and White (1982). The last mentioned study tested the alternative hypothesis that the results which showed subjects reporting more affectively congruent information was due to experimental demand or

attribution processes. The results indicated that affect induction had to work in order that differential remembering of positive or negative events occur.

(c) Congruency between moods at encoding and retrieval

Bower, Monteiro and Gilligan (1978), Bower (1981) report that where subjects are required to learn more than one list of words, and where the learning is conducted under different moods for each list, that there is superior recall for lists in which recall mood is the same as learning mood. Bartlett, Burleson and Santrock (1982) have demonstrated similar results in young children, and have also demonstrated that the congruency superiority does not persist, when the subjects are given relaxation exercises prior to the experiment. Bartlett and Santrack (1979) also showed a mood congruency effect in children for free recall conditions. Finally, Leight and Ellis (1981) obtained state-dependent retention in the delayed recognition of letter sequences. Other results they obtained, indicated that encoding strategy was different in depressed vs non depressed mood; this might mean that at recognition there are advantages of the perceptual and retrieved information having undergone similar encoding processes. Certainly the Leight and Ellis study is the only one in this area, where there are obviously divergent encoding strategies available to subjects (at a presemantic level); this might be a factor in why unlike Bower, state dependent effects were demonstrated without the same subjects having to learn material while in each of two contrasting emotional states.

(d) The emotional content of remembered material

A few studies have looked at the kind of memories which

different kinds of subjects recall. Strongman and Beatson (1981) found that subjects have poor recall of past emotional experiences when in an interview situation. Predominantly memories were of negative childhood experiences. Kihlstrom and Harackiewicz (1982) found that a younger student group retrieved more traumatic experiences than an older student group, when asked to recollect their earliest memories. Robinson (1980) demonstrated that the latency of report is inversely related to the intensity of feeling. Robinson (1981) demonstrated that assessment of the level of affect associated with retrieved memories, is affected by the prior cognitive context. Robinson accordingly argues that remembered affect might be regarded as the product of judgement processes rather than a straight report of encoded memories.

(e) The emotional structure of stimulus materials.

Some recent studies have demonstrated that the emotional content of stimulus materials can influence aspects of recall. Strongman (1982) showed that words within emotional sentence frames were better recalled than those within neutral frames. Strongman (Note 1) replicated that effect, but some aspects of the study cast doubt on whether it is the emotional or the categorical structure of the stimuli that is responsible. Ortony, Turner and Antos (1983) found that in recognition tests, affectively negative foils that had not been seen before, had a higher rate of correct rejections than had affectively positive foils. Elmos, Dye and Hendelin (1983), raised the possibility that the well known affect of spacing on recall (e.g. Glenberg, 1979), might be because of different levels of positive affect associated with the spacing interval.

They failed to substantiate their hypothesis, but their results did show that there was no spacing effect when the words to be studied were connotatively good or bad. Eysenck and Eysenck (1982) showed that when a monetary incentive was associated with words that had to be recalled, high incentive words obtained more processing and were better recalled. Finally, it should be noted that there is a complex relationship between stimulus materials and recall data. Highlighting this is the finding by Manning and Goldstein, (1976), that experimental conditions which result in generally poor performance and low rates of clustering increase the recall advantage enjoyed by taboo words over neutral words. It seems possible that emotional content will lead to apparently contradictory research results unless levels of difficulty are matched from experiment to experiment.

(f) Other emotion related factors

Several other factors have been found to produce effects on memory, or encoding. Firstly, unexpectedness or mental shock has been found to produce memory deficits. For example Loftus and Burns (1982) had subjects view a film and found that fewer details of the film were remembered when an especially violent event occurred in the film. They found that mental shock was responsible for this - not just unexpectedness. Another example is a study by Runcie and O'Bannon (1977) in which it was found that a picture of a nude person inserted in a sequence of to-be-remembered pictures significantly reduced recognition accuracy. Interestingly, a skin conductance measure of arousal was unrelated to recognition accuracy.

Secondly, a uniform result across many studies is that

depressed subjects tend to show a deficit in the recall of positive events. Cole (1980) found that whereas nondepressed subjects recalled positively toned material better than negatively toned material, depressives remembered both types of material equally well. Ingram, Smith and Brehm (1983) found that depressed subjects did not respond to success feedback by recalling more favourable self-references, whereas nondepressed subjects did. Dobson and Shaw (1981) attempted to reduce depressives distortion in recall of positive feedback by having them reality test; they found that the distortions in recall remained, and under some conditions were even accentuated by reality testing. Zuroff (1980) found negative biases in recall which were introduced by failure feedback, only in formerly depressed students, not in currently depressed or never depressed students. This result is consistent with that of Ingram et.al. (1983), in that it indicates that schema activating conditions might differ for depressives and normals.

Not all studies have found evidence of selective memory for negative events among depressives. Roth and Rehm (1980) found no evidence of selective memory for negative events during depression, although they demonstrated that depressives tend to choose negative feedback and to negatively distort self monitoring. Some research has questioned whether it is distorting schema or schema absence that produces negative bias for recall in depressives. Davis (1979a) found only that there was a deficit in depressives for organisation of self-description adjectives. However, earlier work by Davis (1979b) indicated that a self-schema for depressives does develop over time.

A last finding in the affect and memory area worth mentioning, is the non equivalence of results when differing affect histories precede the current (recall) affect. For instance Barden, Garber, Duncan and Masters (1981) found that a second affect-inducing experience did not remediate the behavioural consequences of a prior one. The effect of emotion on recall was not evident when prior to induction relaxation procedures were employed (Bartlett, Burleson & Santrack, 1982). These studies confirm that the contrast effect of the order of presented emotion inducing materials reported by Manstead, Wagner and MacDonald (1983), has an effect on cognitive processes as well as reported affect intensity.

Limitations in the Research

The research listed above in the area of the effect of emotion on memory is still embryonic and working within the limitation of heuristic and often post hoc models. Little attempt has been made to analyse the phenomena in terms of the microprocesses postulated by cognitive psychology. While this has the virtue of ensuring that some studies retain their relevance to real life cognition and emotion (see Neisser (1982) for a discussion of this virtue), the unfortunate consequence is that emotion has come to be reduced to just a code in the cognitive system when it comes to explanation. The cognitive system almost certainly does employ emotion codes (see the evidence of Posner (1978) mentioned earlier). Rather than employing a conceptualisation that has the cognitive system employing emotion codes, it would be preferable to conceptualise results in terms of the

emotion system employing cognitive codes. Such a reconceptualisation promises to overcome some of the inherent weaknesses in most current approaches to the study of emotion and memory:

(1) Present studies confuse the representation of an emotional episode with the cause of experienced emotion.

(*& Cohen*)
Bower_^(1982) has admitted that this is a weakness of his network model and has put forward a blackboard model which allows the distinction between emotion concept activation and emotion activation.

(2) Present studies emphasise the cognitive basis of emotion, and emotion related memory phenomena, at the expense of the study of emotional control processes that regulate cognitive operations. Thus emotion-material congruity effects abound, but little has been done to examine subject material preferences, or encoding levels employed on less emotionally relevant material.

(3) Investigation is not systematically looking for differences at all levels of information processing. Rather, it is tacitly assumed that the additional encoding of emotional material via activation of an emotion node is the only embellishment necessary to the processing system for cold cognitions. There has been very little attempt to find a process (as compared with a structure), focus for results.

Reconceptualisation of the investigation to one of 'how does the emotion system employ cognitive codes', will encourage a more broad ranging investigation of emotion-cognition interactions. The investigation of emotion clearly becomes the investigation of the interactions between two

systems, and not just demonstration of an emotional representation in memory. As well, the reconceptualisation lends itself to a theoretical linkage between cognitive functioning and evolution via emotion. In prospect is an account of cognitive sequences in terms of the behavioural objectives (evolutionarily determined) that they meet. Plutchik (1980) provides a useful typology of such objectives.

The Influence of Affect on Decision Processes

There are a number of studies that demonstrate influences of affect on human decision making. These studies amplify the point made in the last section, that the influence of emotion is not just on the accessibility of material, but is also on the processes employed on information. Toda (1980) provides the elements of a framework for examining the role that emotions play in decision processes. Firstly, emotion makes a certain class of behaviours and decisions readily available, and usually these primed behaviours are suitable to the invoking environment. Secondly, Toda suggests that we may use anticipatory emotions to provide the costs and the rewards to be associated with particular decision outcomes.

Isen, Means, Patrick and Nowichi (1982), also suggest that current affective state may be important in behavioural decisions and demonstrate that current positive affect reduces the tendency to take options that might risk such current affect. Isen and Means (1983) obtained evidence from a task that required subjects to choose the best of a number of alternatives, that elimination by aspects was more prevalent among happy subjects than among control subjects.

Within this task, such a strategy resulted in an increase in efficiency and Isen et.al. (1982) provides other evidence than an increase in creative problem solving ability may also accompany positive affect. Affect has also been shown to produce a global influence on estimates of risk that does not derive from the relatedness of the affect inducer to the situation which is being estimated (Johnson and Tversky 1983). Along similar lines momentary affect has been shown to influence judgements of life satisfaction (Schwartz and Clore, 1983).

The conclusions of Schwartz et.al. are similar to those of Johnson and Tversky; both suggest that momentary affective states are used in computing other assessments, and accordingly we make judgements compatible with our current mood. Such results which implicate current emotional state in the assessment of other matters suggest that emotional assessment may be an important, albeit hidden, factor in a wide range of judgements. Seen in this light, Toda's suggestion of the use of anticipatory emotions in behavioural decisions, is merely an extension of the utilisation of emotion in the assessment of the present. Thus there is some empirical support for his suggestion, although more research must be performed in this area.

One other area where emotion is of relevance in decision making is in how emotionally encoded material can influence normal reasoning processes. Revlin, Leirer, Yopp and Yopp (1980) have examined the effect of controversial premises on categorical inference. They found that there was evidence for a converted encoding of premises that could account for the 'belief-bias' effect.

(The 'belief bias' effect is the tendency for solvers to adopt solutions to categorical syllogisms that are congruent with the solvers favoured belief, in preference to correctly deduced solutions). Thus, Revlin et.al. argues that Americans will have the tendency to encode "All Bolshevicks are Russians" as "All Russians are Bolshevicks". Evans, Barston and Pollard (1983) controlled for conversion and still found belief bias was a significant factor that was more marked on invalid than on valid syllogisms. Hammond (1976) working within a different framework, points out that there can be considerable conflict between parties with fundamentally the same decision function. He argues that such disagreements can arise because of the limited capacity of the decision maker involved in quasirational judgements. In short, Hammond downplays the influence of non cognitive forces in human judgement distortions. Yet here what is being downplayed is the extent of Freudian rationalisation in reasoning processes. Hammond is still consistent with the observation of Einhorn & Hogath, (1981), people interpret stimuli rather than respond to them; here stored affect must be thought important.

A study which emphasises the way in which affective factors may be important in influencing the way that new information interacts with old and alters conclusions is that of Sherman and Voss (1982). They showed that the information recalled from a prose passage about the USSR, was influenced by the attitude of the subject, when the passage was congruent with the established beliefs of the subject. When the passage was incongruent with the subject's expectations, then the subject's knowledge of USSR was

predictive of passage recall. Taking these results together, there is evidence that an affective predjudice dominates and facilitates encoding with new information under some conditions.

Attitudes taken into a situation can also be critical for the processing that occurs in the situation. Boggiano and Hertel (1983) demonstrated this in an experiment where an initial attitude towards a task was found to produce a differential ability to recall information that was congruent with the attitude. Thus, it must be concluded that for decision processes working with stored information and new input, the decision procedure is likely to be prone to effects deriving from the encoded attitude. A major perhaps defining difference between the concept of attitude and the concept of stored information is the affective component postulated for attitudes (e.g. Fishbein and Ajzen, 1975).

There is also another path whereby stored information may influence decision, and that is, if the content of the stored information is congruent with an irrational belief system, then negative affect might be triggered and produce resulting changes in decision processes. Rohsenow and Smith (1982) have demonstrated that the extent that subjects subscribe to the irrational belief set of Ellis (1977), predicted the daily emotion ratings of the subjects. So as well as the influence of affective markers stored with information, the actual content of information stored will have consequences for emotional activity and decision processes.

Implications of the Emotion-Decision Making Research

The effects of emotion on decision processes can be regarded as consistent with the well known effects of emotion on action tendencies (e.g. O'Malley & Andrews 1983, Masters, Barden, and Ford, 1979, Aderman 1972). The study of emotion-decision process interactions is a necessary part of the study of the effects of emotion on behaviour. This is because decision processes are the precursors to actions and except in non reflective actions, can be considered to be determining. Since such well defined consequences of emotion can be demonstrated, the possibility of a theoretical linkage between emotion theory and evolutionary theory is raised. The memory data may become more predictable within such a scheme.

For instance Tversky and Kahneman (1973) put forward as a factor in decision making the 'availability heuristic', and they show that one estimates the frequency of a class by the ease with which its instances are brought to mind. This heuristic becomes highly functional if at times of danger or threat, previous negative experiences are more readily brought to mind, and the associated behavioural options are more frequently avoided than at low risk times. The effect of emotion state memory effects in combination with the availability heuristic is to avoid the compounding of risk factors in situations of threat. By similar reasoning, risk factors will be underestimated at times of comparative advantage, and the exploration of new behavioural options is more likely at such times.

The evolutionary significance of emotion has long had a place in the explanation of the form and function of

emotions (e.g. Darwin, 1872). However, apart from studies on the universality of expressions and their interpretation across cultures (e.g. Ekman and Friesen 1971, Izard 1977), psychologists have tended to study emotion within the cultural context rather than the biological context. To an extent this reflects the fact that the significance of emotions is to be found in various strata of the organism. For instance, it is possible to trace the effects of emotion on the physiology of the organism, on behaviour, on phenomenology, to name a few of the possible levels of analysis. But not all strata are equally relevant to a biological-evolutionary perspective, and the psychologists pre-occupation with defining stimulus-invariant behavioural sequences places explanations in terms of situations and responses at a premium - to the expense of a more biologically relevant approach. The problem is that contemporary emotion theories (with some exceptions) devote themselves to the analysis of all situations where affect is encountered, and does not make two fundamental distinctions in the data base of emotion:

- 1) To divide performance into incidental and invoked performance.
- 2) To divide competence into designed competence and obtained competence.

The first dichotomy above divides emotion data into primary and secondary components of performance. For example, changes in arousal states are ubiquitous for emotions yet these are merely enabling aspects of emotion and do not contain any consequences for interaction with the environment, except those consequences carried by the action

sequences with which they correlate. Contrast arousal as a secondary performance component, with facial expression which carries information and will provide responses from cohabiters of the environment. In as much as facial expressions alter the environment, they are a primary component of performance, and of great interest. This first division separates the data of relevance to an evolutionary perspective on the design of emotion systems from data that is incidental to such a perspective.

The second dichotomy is less straight forward, and requires dividing the competencies underlying performance into those of an evolutionary origin, and those of a social origin. Of course, the dichotomy is partly false since it has been pointed out that the interaction between inheritance and experience is important in accounting for behaviour (e.g. Woodward 1982, Patry 1983). The important distinction between these two competencies is that those of a social origin are available only with the correct learning sequence, whereas there is a degree of innateness about the evolved competency. (See Schilcher, (1982) for a discussion of the limitations of the innateness idea). Innateness as used here does not mean unlearned, because most behaviours and psychological processes have a learned component. Rather, innateness is ascribed when the competency is not part of a socially evolved solution to an environment. Any socially evolved solution will of course be dependent on biological components (even if only because the physiological structure making movement possible is genetically determined). It is very important then to show the historic origins of behavioural complexes because they can demonstrate what

aspects of the complex are socially evolved.

The residue from excluding incidental performance and obtained competence is the data base for developing an emotion theory linking psychological and biological substrates.

The suggestion developed in the previous paragraph that emotion theory base itself on the consideration of data with particular characteristics is developed more fully in the next chapter. The fundamental idea is (as the section on the affective influences on decision making highlights) that there are few situations in person-environment interactions where affect is not implicated in the decisions. But, while affective influences are pervasive, it is best to develop separate theories about the design of emotion, systems, and about the utilisation of emotion systems. Psychology has to admit its cultural determinants and divide its efforts between discovery of principles that need no referencing to the culturally determined learning environment, and between a contentful psychology that is referenced to the meaning structures within a culture.

The division of the data base has been advocated in the light of the impressive demonstrations of the effect of emotional states on decisionmaking does not just carry implications for a biological-functionalist theory of emotion. It also suggests that we take seriously as a separate question just how we can use assemblages of mental structures tied together via cultural symbol systems to produce desired behaviours. That is to say, as well as the question of adaptive psychological structures with respect to the general idea of environment, there is also the question of specific information processing abilities and response

sequences to particular environments. Binnie-Dawson (1982) in outlining a bio-social approach to environmental psychology notes the interaction between biological and social influences on the psychological system and that "...the functionalists were concerned with the study of adaptive acts in relation to the general concept of environment, they were not concerned with adaptation to specific environments" (p.407). In line with Binnie-Dawson's recognition that many processes are bio-social in origin, and also consistent with theorists who suggest gene-culture coevolutionary processes (e.g. Wilson and Lumbsden, 1981), it is acknowledged here that biological-functionalist theories of emotion are not on their own sufficient to account for human behaviour. They must be supplemented by theories that account for the learned adaptations in human capabilities.

Chapter Overview and General Discussion

This chapter has looked at a wide range of research from that of the emotion attribution literature to the influences that emotional states have on human decision making. Emotional states are very difficult to measure, and there is a cultural input to what people recognise as an emotion, making the study of the effects and functions of emotion extremely difficult. The distinction between emotions and the behavioural consequences of emotions is to an extent fostered by the scientific and therapeutic convenience of such a scheme, and might not be the best way of understanding emotion. Considerable controversy has been engendered by the artificial and too general categories being employed by emotion theorists. The dispute over whether

cognition is necessary for affect is one such non issue which has been considered in this chapter. Another area where emotion theory might be suffering from the breadth of a used construct is in the two factor theory arousal attribution approach.

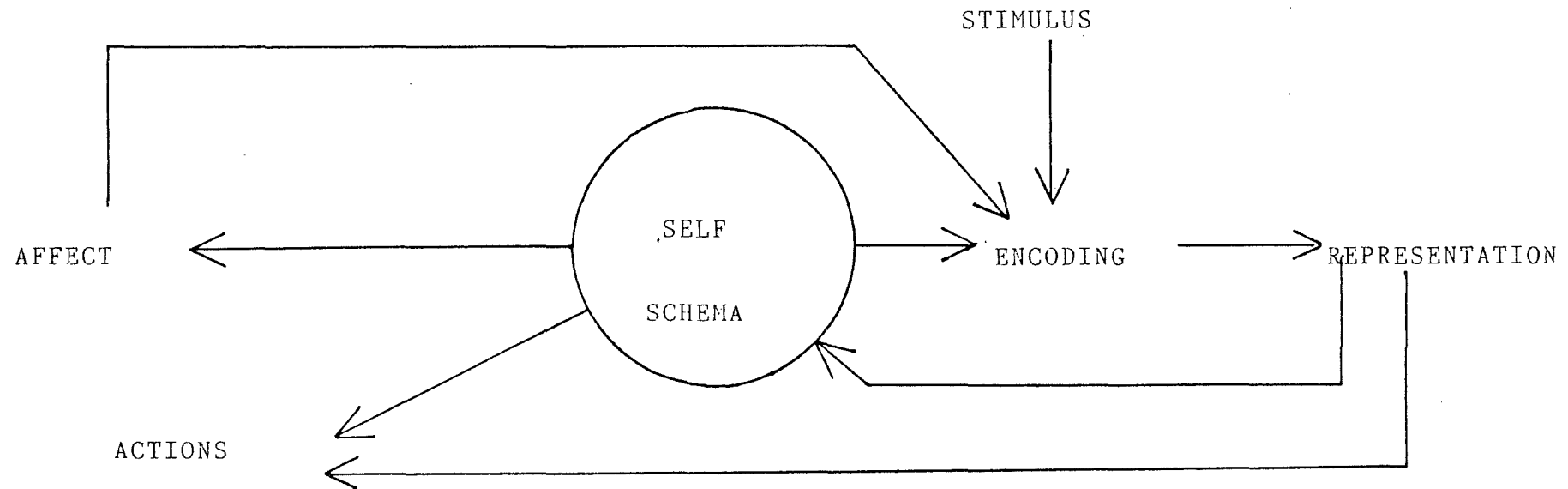
When the influences of emotion, and the processes contemporary with emotion, on cognitive processes were considered, it was evident that much of this research is piecemeal in nature. The outline of the conclusions of Eysenck (1982) in the area of arousal and memory, demonstrated that simple theories such as Walker's (1958) action decrement theory provide ready interpretations when it comes to single experiments, but are inadequate to integrate the findings across the entire field. It was also questioned whether more complex cognitive theories that originate from a componential cognitive meta-theory are adequate for explaining emotion. It was suggested that most of the research conducted in the area of emotion and memory suffered from the lack of a theoretical structure with which to organise the results by. An acknowledgement of the inadequacy of the most employed semantic network model of emotion processing by its author (Bower and Cohen op cit), demonstrates this point. The work on the influence of emotion on decision processes was considered significant to the development of emotion theory. Firstly, it is not tied as tightly as the memory research to a cognitive structure account of its results, and secondly the connection of these results with the functional significance of emotion (in a biological sense), seems possible and explanatory.

There is no clearly advantageous approach or meta-theory

that has emerged out of the issues in this chapter. However there is the suggestion that emotional processes are best conceptualised as operating on and changing the nature of normal cognitive functioning. It is also clear that the self-schema plays an important part in regulating affect and conversely affect is important in the ongoing operation of the self-schema. Thus there seems to be some evidence for Epsteins (1982) suggestion that emotions emerge out of events of significance for the personal theory of reality incorporated within the person. Epstein suggests that the personal theory of reality arises out of the need for the infant to maintain a favourable pleasure/pain ratio, and is thus intimately associated with the experience of emotions. He suggests that emotions typically occur when a theory of reality succeeds or fails in its functions of assimilating experience, maintaining a favourable pain/pleasure balance, and maintaining a favourable level of self esteem. It is suggested here that a theory such as this one is a useful aid to the organisation of the results reviewed in this chapter.

In Figure (1-2) a slightly expanded representation of Epsteins theory is presented. An unconscious self schema directs encoding by referencing input to itself, and that input is then represented in the cognitive system. The object-person representation in the cognitive system may not correspond to the object-self relation in actuality because it is arrived at after the mediation of other material stored in memory. Thus for example I might not have a conscious representation of teacher as self imperiling because that is not congruent with the culturally determined

FIGURE (1-2). A DIAGRAM OF A MODIFIED VERSION OF THE MODEL OF EPSTEIN (1982).



The self-schema influences object encoding. The encoding process results in a representation of a situation. Processed elements of the situation are related via the self-schema, and may result in affective states that will influence encoding and response tendencies. Actions are decided on through both conscious heuristics that operate on representations, and unconscious heuristics that are applied via the self-schema.

description of teachers as wise and helpful. Nevertheless, other information processed automatically will be monitored by the self schema, and will influence the fundamental approach-avoidance tendency. For instance, teacher's posture, gestures, tone of voice will be summed by the self schema, and approach avoidance tendencies determined. Affects then can be regarded as the sensational basis whereby the 'primitive' self system experiences the world. Affects are relational in the sense that they form an experience between subject and object or subject and world. (This has been suggested elsewhere by Rival (1977)). Affects are actional in that they carry evolutionary significance and produce action tendencies and also representational tendencies. That is, affective states will induce the cognitive system to emphasise relational encodings congruent with the affective state.

This sketch of a theory of emotion will be expanded in a later chapter, but here, it should only be noted that data can be organised about a number of categories that derive from this model.

(a) Stimulus influences on affect.

It has been suggested that some stimuli invoke genetically determined responses (e.g. Kartsounis and Pickersgill (1981)). These stimuli do not derive their affective significance from learning experiences.

(b) Affective influences on encoding and representation

Here much of the literature on emotion and memory lies. For instance, the work of Bower et.al. (1981) which showed superior recall for material congruent with mood at encoding.

(c) Situational encoding by self schema

This is an incidental category that would include the

evidence of Bower (1981), Bower et.al (1978) for emotion state dependant effects. It would also include much of the emotion attribution literature. Non attributed arousal is monitored by the self schema and can give rise to genuine affective states which in the case of Bowers memory experiments can operate as event markers.

(d) Representational influences on affect

This interaction is predicted from figure (1-2). The self schema operating on the object representation and automatically encoded situational information will produce a fundamental approach-avoidance action tendency that will be affectively coloured by the object-self relationship which it is primed to react by. Certain representations will lend more support to self-schema interpretations and thus will lead to greater affect. For instance, Lang (1979) found evidence that greater arousal was obtained from image response training than image stimulus training.

The significance of these categories is to remove data from reference to experimental paradigms and into relationship to theory. Also, the categories emphasise that the self-emotion system can be regarded as a system that utilises the cognitive system and must be regarded as non reducible to the properties of that system.

The suggested categories do not amount to a new conceptualisation of emotion, nor should they be regarded as the best way of dividing research issues deriving from Epsteins theoretical position. They are put forward at this point of the thesis; partly to provide an example of an alternative to the piecemeal way emotion research is presented within the dominant cognitive meta-theory; partly

because the categories exist also as questions which must be answered by emotion researchers. The categories will thus be addressed again later in chapter 6 which looks at the development of a theory of emotion.

We conclude again emphasising that the review presented here has found that the study of emotion by cognitive psychologists has raised some interesting phenomena, but that cognitive metatheory has to date not provided a useful understanding of affect. This thesis emphasises that the question of emotional codes within the cognitive system should not supplant the study of how the emotion system employs cognitive codes.

Chapter Two: Genetic Systems, Emotion Systems, Personality Systems.

Introduction

This chapter concerns itself with the question of how a theory of personality can be developed that is capable of explaining personality processes through an understanding of behavioural, physiological, and genetic processes of structures. Miller (1978) suggests that there are emergent properties which are characteristic of complex systems and are more than the sum of lower order system outputs. These he suggests are not to be discussed in vague and mystical terms, but must be understood with reference to the concepts used in the understanding of lower level systems, with other necessary new concepts added. If we regard personality as an emergent property of the interaction of the various emotional, motivational, cognitive, action, and perceptual systems that play a part in human information processing, then it is necessary that the influences which each of the subsystems has on personality processes be studied. Otherwise a purely trait based personality psychology falls into the trap of equating a measure of behavioural regularity with an explanation of that behavioural regularity (Hampshire (1953), Buss and Craik (1983)). While the role of traits in scientific explanation is not totally settled (e.g. Hogan (1983), Rorer and Widiger (1983)), it would be hard not to agree with Posner (1981) when in calling for an approach to individual differences that links theoretical concepts to underlying biological mechanisms he wrote: "...the attractive part of the psychobiological approach to individual differences appears to us to rest on its promising of

information about the relative organisation of internal mechanisms within an individual, rather than being merely a means to compare people on some attribute.... If intraindividual differences in the structure of mechanisms can be combined with a detailed information processing framework, we might be able to develop a more satisfying approach to the problem of individual behaviour." (p.34-35). In line with this hope, the present chapter looks at the nature of explanation in extant personality theories, and outlines some of the considerations needed in the development of a unified psychology of the human being.

The Structure of Personality Theory

Maddi (1976) differentiates the parts of a personality theory into core statements, developmental statements and peripheral statements. As well, personality theory contains connections between these higher order statements and data statements about the thoughts, feelings and actions of the individuals who the personality theory is used to make more comprehensible. Such different levels of personality theory can admit the involvement of biological, motivational, emotional etc, subsystems, primarily through its core statements, and its peripheral statements. Developmental statements are taken to be statements about the interaction of core tendencies and characteristics of the outside world. They involve the structures and processes identified by the core statements, ^{to} which they add those conditions of the world that influence developmental processes. Developmental processes produce the periphery of personality that manifests as personality types and

characteristics.

In terms of the biological and biologically correlated functional systems of the person, developmental statements involve the characteristics of the subsystem, and the characteristics of the environment in their nexus of explanation. The range of peripheral personality possibilities is limited by the nature of the biological subsystems, with the environment the determinant of which subset of the range of possibilities becomes the persons operating characteristics. The peripheral statements are dependent upon the interactions between the processes identified by core statements and the formative processes identified in developmental statements. It is thus clear that in assessing the degree to which a personality theory can be an integral part of a general theory of living systems, the evaluation is possible by surveying the extent to which the core statements can be linked to statements about other subsystem processes and structures within the living organism.

In surveying Maddi's listing of the statements concerning the core of personality, one finds that most of the theorists he covers have core statements that do not totally rule out the possibility of statements linking the existence of functioning of organismic subsystems to the emergence of personality processes. In agreement with this observation Miller (1978), finds it possible to draw parallels between the theory of living systems and the personality theories of Murray, Freud, and Menninger. The parallels that Miller ^{draws} between his theory of living systems, and these personality theories, could be extended to a large number of other theories of personality. The extension

would be bounded by existential theories of personality such as those of Binswanger (1963) and Boss (1963) who call for existential psychology to remain with experienced and experienceable facts and phenomena. Miller does distinguish theories of personality from his theory of living systems; extant personality theories deal with abstracted systems, whereas the approach that Miller takes works with concrete systems. Miller argues for the advantages in working with concrete systems, so it is worth considering why the study of personality processes has fallen within the theoretical framework of abstract systems. But first the distinction between abstract and concrete systems will be outlined.

Concrete and Abstract Systems

"A concrete, real or veridical system is a nonrandom accumulation of matter-energy, in a region in physical space-time, which is organised into interacting interrelated subsystems or components." (Miller 1978, p.17).

"The units of abstracted systems are relationships abstracted or selected by an observer in the light of his interests, theoretical viewpoint, or philosophical bias. Some relationships may be empirically determinable by some operation carried out by the observer, but others are not, being only his concepts." (Miller 1978, p.19).

The fundamental distinction between an abstract and a concrete system can be demonstrated by contrasting the kinds of statements about system properties under the two approaches. In concrete systems the scientist discovers A that has the property r, whereas in abstract systems the problem becomes one of finding an A that has the property r. The practical

reasons for preferring concrete over abstract systems which are given by Miller are:

- 1) Concrete systems embedded as they are in space-time coordinates, adhere to the concrete world which we experience. This makes the theory of concrete systems easier to comprehend and develop than the theory of abstract systems.
- 2) Total system variance is composed of variation in relationships, and the variations produced by individual units. Only concrete system theories allow for the variance associated with uniqueness of the individual unit.
- 3) Concrete system theory is more complete, because it is constrained to take into account the markers that transfer information from system to system. (For example, abstract system theory has no way of integrating the contemporaneous change in the abstract systems of roles (citizen to prisoner) and sustenances (steak to bread).).
- 4) Cutting across the lines of cleavage of a concrete system in obtaining the conceptual boundaries of abstract systems, threatens conceptual confusion when it comes to reconstitute the total system from its abstracted subsystems.
- 5) Natural sciences work with concrete systems, and if the social sciences were to take the same course, then the unification of all the sciences would be accelerated.

Lorenz (1981) points out that just as the physicist, so the biologist proceeds from the bottom to the top, or from the particular to the more general. Thus Lorenz (1981) states:

"As investigators of behaviour, we hope in the end to trace the phenomena which we study back to physical and

chemical processes such as those that take place at the synapses, among the electrically charged cell membranes, and in the conduction of excitation" (p.17). The point being made here is that the behavioural scientist moves from particular behaviours, to the explanation of the behaviour through reductionism. This should not be regarded as trivial, for as Chance (1980) points out, in the moving from behaviour to physiology in the case of the investigation of the orienting reflex, behaviourists have neglected doing a complex behavioural investigation of the specific nature of the orienting reflex. The lack of investigation at the behavioural level Chance argues, has led to an imperfect scientific understanding of the phenomena.

Personality theorists with the possible exception of theorists of a behaviourist persuasion, have started with the careful study of the phenomena that require explanation. These phenomena include behaviour patterns, thought and feeling patterns, imagery and cognitive structures. In Lorenz's terms personality theorists have started with the particular. However, it is argued here that they have been seduced through employing abstract systems, into not attempting to relate the specific behavioural and thought patterns discovered, to a more general theoretical framework. They have used the embarrassing richness of the contents of personality phenomena to provide abstract systems with which to account for subsets of personality phenomena. They have then attempted to extend their systems by overgeneralisation, or by increase in the number of orientations that the abstracted relationships are derived from.

Examples of Abstract Personality Theory

Some justification of the strong statements of the last sentence are needed. Since the order of generality is such that most of the personality theories of the last hundred years are included by implication, a fair and exhaustive justification is beyond the bounds of this chapter. Instead, it will be shown that two major exemplars of personality theory have incurred costs by remaining abstracted system theories, and it is argued that most personality theories lie on a continuum of which the two chosen theories form poles. As well, evidence will be presented that many modern personality theorists are aware of the impendance to the development of trully comprehensive theories of personality. These theorists are moving away from abstract systems, and although they do not voice their concerns in these terms, there is a developing trend in modern personology towards theories of personality that integrate the theory of personality with knowledge derived from the scientific investigation of biological systems.

A personality theorist who stands at a methodology driven end of personality theorising is R.B. Cattell. Cattell (1977) has asserted that trait based explanations are necessary in these terms:

"The question of whether traits exist in the meaning given here - that of a correlation cluster (surface trait) or of a unique invariant factor (source trait) in behaviour manifestations, as correlated over time or over people - is a matter for experiment and calculation, not apriori theories." (p.167).

It is clear from this statement, that given that

psychological variables exhibit any kind of correlational structure at all, that this approach by virtue of its methodological necessity, will yield traits to embellish a theory of personality. The emphasis that Cattell places on the inductive nature of hypothesis formation also testifies to his concern for a ready account of the surface structure of his data. It would be unfair to Cattell to claim that he totally dismisses the importance of deduction and experimental confirmation in his approach to theory building, neither is it true to say that he has regarded empirically invariant factors without reference to the wider body of psychological knowledge, to be sufficient for theory building. The approach that Cattell takes though, is nevertheless guaranteed to generate a structural model of personality and personality processes, and the nature and completeness of the model is dependent on the nature and completeness of the personality domain samples. Pervin (1975) has summarised this and a number of other objections to the validity of Cattell's empirically driven approach to personality theory. When the problems of sampling are aligned with the problems in assuming that factor analytic categories represent underlying structures (cf Overall, 1964), then the obvious danger is that Cattell's system has managed to contain the variance rather than explain the variance. The extent to which the inductive factor analytic approach of Cattell has been adequate in terms of being a coherent and comprehensive theory of personality will not be considered here, but the point being made is that his methods generate an abstract system theory, which overgeneralises explanatory concepts at places, and is not initially constrained to cut the

planes of organismic functioning in accord with the structure of the physical system.

A second personality theorist whose theory derived from clinical experience is in contrast with that of Cattell, but has had an even greater impact on personality theory is Freud. In spite of his early formulation of a project for a scientific psychology (Freud 1966a), in terms distinctly similar to modern nodal network theories (Wicklegren 1979, Collins and Loftus 1975, McClelland and Rummelhart, 1981), the later Freud was content to state that the location of mental life was the brain, but that "...our acts of consciousness, which are immediate data and cannot be further explained by any sort of description." (1966 p.144). Freud saw the more extensive knowledge of the neurological substrate as merely providing a localisation of acts of consciousness and as being of no help in the understanding of these acts of consciousness. On the other hand, the identification of the id with "...everything that is inherited, that is present, at birth, that is laid down in the constitution...", points towards the acknowledgement of the importance of neurological organisation and function in explicating (Freud 1966b, p.145) the unconscious areas of psychic life. Indeed this importance of biological factors on the determination of conscious life is the second fundamental principle of psychoanalysis (Freud 1966b, p.158). It is thus, hard not to come to the conclusion that Freud was committed to a psychology that rooted the causes of consciousness in the biological substrate. He saw that the processes of scientific observation and inference should be, used on "...the breaks in the sequence of psychical

events...¹", in order to understand the nature of the processes that give rise to consciousness. Freud's commitment to the formulation of his theory of personality in a manner which allowed a strict psycho-physical parallelism, certainly is evidence that it was the intention of Freud to develop concrete rather than abstract system theory.

Unfortunately the expressed commitment to psycho-physical parallelism, did not result in Freud's development of his personality theory in a form which made it possible to tie together the contents of experience, and the biological substratum in any tangible manner. This is reflected in the degree to which the psychological structures thought to be important in the ebb and flow of mental life received personification in Freud's writings. There are many instances of this metaphorical quality in Freud's papers, a typical example is found in his lecture entitled 'Dissection of the Personality', given in 1932, where he discusses the nature of id-ego relations: "The relation to the external world has become the decisive factor for the ego; it has taken on the task of representing the external world to the id - fortunately for the id, which could not escape destruction if, in its blind efforts for the satisfaction of its instincts, it disregarded that supreme external power."² Davidson and Neale (1978) also observe the reification of this metaphorical characteristic in Freud's writing, and Mischel (1976) notes also the difficulty of integrating some of Freud's picturesque language with scientific psychology.

Given then, that Freud employed metaphors that frequently used the personification and animation of his theory's

¹Freud 1966b p.159

²Freud 1966c p.75

psychological structures to convey the dynamics of psychological functioning, does this of necessity remove Freudian theory from being aligned with the concrete systems theory advocated by Miller? Freud's psychology as exemplified in the examples cited here certainly has the problem that the markers that transfer information from one system to another are not specified. The famous reference (Freud 1966c p.77) where Freud compares the relation of the ego to the id with that between the rider and horse exemplifies the deficiency in the language in which his theories are formulated. While important relationships are afforded by the analogy, and the range of relationships offered by the analogy might well encompass the range of relationships observable in everyday living, the parsimony offered by the analogy in describing behaviour, in no way compensates for the inability to infer organic processes from such descriptions. Freud of course moved freely between the personification of his constructs, and the language of cathexis and instinctual energies. But while energy conservation was an important restraint in his model, energy relations, and the topological regions of personality, can hardly have been said to form a bridge between Freud's abstract analysis of psychodynamic processes and the biological constraints of the functioning system.

The brief discussion of the personality theories of Cattell and Freud, has demonstrated that there is a major gap between theories of personality, and other theories of behaviour. Such a gap is not necessarily undesirable, given the complex influences of socialisation and culture on the development of the personality. However, what is most

undesirable is the demonstrated prospect that in formulating theories of personality, the divide between this area of scientific endeavour, and the areas of scientific endeavour outside of personality theory grow irreconcilably large. Unless there is a commitment, based on good evidence, that evolutionary processes and their concomittant biological structures and predispositions are of no influence in those behaviours that form the data of personality theory, then any approach that threatens to divorce personality theory from the rest of human psychology must be looked at with alarm.

The comments just made on the wide seperation between personality theory, and other subareas of psychological and biological science, reflect a general disquiet amongst psychologists as a whole about the relevance and scientific status of much personality theory. Posner (1981) has highlighted the potential of the information processing framework in conjunction with the knowledge of biological mechanisms as an approach that might be more satisfying in terms of understanding individual behaviour than that provided by cognitive style, psychometric, or pure information processing theories. He concludes that "...goals in both developmental and adult research may best be realised only if research in information processing is linked to biological mechanisms of attention."

Amongst other more mainstream investigators of personality and individual differences, a recent important volume contains two calls to place personality theory with respect to biological and evolutionary processes. Bem (1983) argues that 'personological theorists' in order to

have a common set of variables for characterising all persons must refer to genotypic features rather than what he describes as "...the phenotypic hybrids of person and environment that abound in the lay persons lexicon, for these are precisely the kinds of descriptions that have varying relevance across persons and, hence are useful only for characterising subsamples of the population." (p.207). In the same volume, Hogan (1983) notes that the various personality theories are projections of their author's own biographies which their authors claim to be universal afflictions. Hogan argues for a point of view on personality that has a more impersonal perspective. He puts forward a socioanalytic theory of personality that is considerably influenced by evolutionary theory. He posits certain fixed biological motives being very important in forming the core of "human nature", and the stuff of person variation.

It is thus becoming clear that the subjectivity of traditional personality theory is of concern to contemporary theorists. There is a widespread recognition that one way of overcoming this subjectivity is by referencing theories of individual differences to theories relating to the underlying biological substrate. Unfortunately there is a fatal logical flaw in the way in which some of these proposals are formulated, and this will be discussed in the section relating genetic systems to personality systems. First, two other approaches to the study of personality of contemporary origin will be briefly examined, because they represent the most significant alternatives in the field besides the call to biological-evolutionary naturalism.

Some Recent Developments in Personality Research

The act frequency approach to personality has recently been advocated by Buss and Craik (1983). They regard dispositions as natural cognitive categories, with acts as members. Dispositions function as summaries about behaviour up to the present, and by the implication of character continuity, these summaries should be good for the future as well. In adopting this approach, Buss and Craik argue that they are distinguishing the distinct scientific endeavours of mapping regularities in conduct, and that of providing casual or explanatory accounts. The act frequency approach however goes beyond merely being a method, its position is that dispositional constructs are categories of acts emerging as a consequence of sociocultural evolution. By following this line, the act frequency approach shifts the endeavour of explanation from that of predicting behaviour, to predicting perceptions. The major demonstration of the act frequency approach is that of high composite reliability of prototypicality ratings for act categories. This shows that taking all observers together for a given reference person, there is likely to be a high degree of social consensus about that person after a comparatively short period of time. Such a possibility suggests a large number of new ways of studying personality (for instance the consequences of repeated act incompatibility on trait ascription, the consequences of trait ascription on act frequency), but it does not substantially address the question of whether there is at some level, fundamentally different organismic structures, that differentiate personality types. With the act frequency approach to

personality, the question of whether personality types underlie act categories still awaits a theoretical basis. This is acknowledged by Craik & Buss in their paper when they suggest that the act frequency approach and various explanatory systems could offer an important road to the revival of theoretical discourse in personality. Even though the approach reflects a major shift in emphasis for personality theory and its agenda during the next few years, Mischel, 1983; Epstein, 1979, 1983; exemplify others that use new methods to obtain reliable act categories), it does not contradict a call for a biological-evolutionary approach to theorising about individual differences. Rather it promises to enhance such an approach with more reliable measures of individual dispositions.

A second major approach to studying personality which is gaining momentum as a potentially fruitful way of approaching the problems of personality theory, is the systematic distortion hypothesis framework. Schweder (1982) in discussing the relationship of the systematic distortion hypothesis to trait based classifications says: "The systematic distortion hypothesis is a critique of the validity of personality classifications induced from memory-based personality ratings, implicit personality theory, or conceptual association judgements. The hypothesis implies that if one were to eliminate error and systematic bias from memory-based personality data one would not discover global traits, broad syndromes, or general factors, but rather a complex of context-dependent truths, person by situation by response mode statistical interaction effects, and unstable intercorrelations among events, or alternatively said, that

which is accurate in personality ratings would not support a global trait approach to individual differences in conduct." (p.82). The statement above ties the systematic distortion hypothesis to the criticisms of trait theories and measurements initiated by Mischel (1968). It goes further than these criticisms, in that it posits the existence of systematic distortions in the memory based ascription of traits, which is an addition to the problems of cross situational stability and temporal reliability.

The question that must arise with such a radical departure from the global trait model, is what does this approach leave the personologist to do? In its most radical form, the systematic distortion hypothesis would argue that there is no necessity nor is it desirable, to posit traits and because of this, it easily can be aligned with a behaviouristic formulation of personality. But in fact, Schweder acknowledges the existence of traits, but argues that they predict too few of the people too much of the time, and that our memory based ascriptions of trait are systematically distorted.

The systematic distortion hypothesis does not represent a new thrust in theorising about personality, rather it points out the inadequacy of existing theories working within the frameworks provided by concepts taken from the traditional trait lexicon. Much of the data that it has given rise to demonstrates the lack of correlation between actual and rated behaviour (e.g. D'Andrade 1974, Shweder and D'Andrade 1980). It is clear then, that systematic distortion theories represent a significant critique of traditional trait theories, and can also be seen as a recommendation for the biological-evolutionary approach to

be outlined here.

The brief look at two significant trends in contemporary personality research, has demonstrated that a biological-evolutionary approach to the field of personality is not incompatible with some current trends in personality theory. The next section will outline some of the framework of such an approach, and also contrast the framework with that used by other genetically orientated approaches to the study of personality.

Sociobiological Insights

Sociobiology has been defined as "The systematic study of the biological basis of all forms of social behaviour, including sexual behaviour and parent-offspring interaction, in all kinds of organism" (Lumsden and Wilson 1981, p.382). While it has received extensive criticism (e.g. Cooke, Cooke, Fuller, Griffiths, Orbach, Schwartz and Young 1976, Caplan 1980), as being ideological and essentially untestable, its influence on current theories of anthropology has been waxing (e.g. Bixler, 1981 ; Chagnon, 1980). No complete justification for its theories can be given here, (nor should be), but there should be no hesitancy in accepting that legitimacy of a scientific investigation of the extent to which forms of social behaviour are biologically determined.

The insights of sociobiology promise to be very relevant to the field of personality for two reasons. Firstly because as is pointed out by Hogan (1982), & Jung (1953), much of what we call personality emerges in the course of social interaction and the presentation of self in the context of social behaviour. Sociobiology is being addressed

to the biological determinants of social behaviour, can encompass personality as the manifestation of regularities in individual social behaviour. A second reason for the relevance of sociobiology, is that it promises to provide a theoretical base which can incorporate the findings of various existing personality theories. For instance Leak & Christopher (1982) find impressive parallels between sociobiology and Freudian theory. The ability to integrate theoretical and empirical findings within a more pervasive framework, is an important characteristic of major scientific advance (Kuhn 1970), and while the fruitfulness of the new framework must be evaluated, the prospect of a more comprehensive basis for psychological theory is exciting.

I Evolutionary Stable Strategies: Implications for Personality Theory

One useful tool or concept that personality theory can borrow from sociobiology, is the application of game and optimisation theory which can be used to demonstrate that particular behaviours constitute evolutionarily stable strategies (ESS). Dawkins (1980) defines an ESS as a strategy that "...if, given that more than a critical proportion of the population adopts it, none of the alternative strategies does better." (p.332). While this definition is suggestive of behavioural invariance across the members of the species, elsewhere, Dawkins makes it clear that the term can be applied on a population basis and in this case ESS refers to the population mix of the various kinds of behaviours. The distinguishing feature of an ESS, is that the viable strategy set is frequency dependant and will tend to stabilise on the ESS solution. That statement is best illustrated by an

example taken from Dawkins (1980): In a world peopled by hawkish people who fight viciously until seriously hurt, or they win, and dovish people who fight formally, and always surrender to hawks, the factors leading to the ESS mixture of types in the population can be illustrated. In a world peopled only by hawks, a lone dove will have a greater inclusive fitness than the average hawk, because the chance of serious injury for the dove is minimal (although presumably the dove will also have less access to the resource base). On the other hand, in a world peopled exclusively by doves, the lone hawk will have greater exclusive fitness than the average dove because it can have total control over access to the resource base, with zero chance of this access costing physical injury. From these two extreme possibilities, it can be seen that different rates of reproductive success for hawks and doves, will mean that there will be a shift to an optimal proportion of hawks and doves (given the existence of the two alleles in the population).

As regards personality theory, one benefit which the notion of an evolutionarily stable strategy has is in providing an heuristic for understanding the genesis and stability of genetically determined personality types. It promises more than just this genetic justification of personality typologies. Dawkins (1980) has extended the concept of evolutionary stable strategy, to the domain of the single life cycle, and has shown that such stable strategy concepts are useful in the understanding of animal behaviour, and cultural trends. One particular example is to be found in the behaviour of pigs in a skinner box. In

such situations, it is found that the usually dominant pig does a major part of the bar pressing, and the submissive pig could accordingly get a major share of the food (Baldwin and Meese cited in Dawkins, 1980). Dawkins argues that the particular arrangement in this situation is an example of a developmentally stable strategy, because the only other strategy which is to have the submissive pig bar press would not be viable, since the submissive pig would not get access to the reinforcer due to the presence of the dominant pig at the feeding trough. The stable strategy is stable because the dominant pig can obtain some reinforcement after bar pressing by pushing aside the submissive pig.

The concept of developmentally stable strategy can be applied to the domain of personality development, and it promises to yield a more sophisticated understanding of the relationship between genetic tendencies and situational factors than that put forward by many genetically oriented personality theorists. Eysenck for instance postulates a high heritability for personality (Eysenck 1980, 1979, 1977), and while he acknowledges that variation cannot be totally attributed to either environmental or genetic factors, the call that he makes "... to partition the total variance in any situation in such a way as to lay bare the various genetic and environmental factors involved in it¹", points to a concern with attribution of the developmental course, rather than a dynamic approach. A dynamic approach would show how the environment interacting with the genotype defines the personality-type distributions that different developmental

¹Eysenck (1980) p.123

environments might produce.

It is not surprising that Eysenck's work on heredity and personality has recently been questioned by Masqud (1981), when he found that there was no relationship between children's scores, and those of their parents on Eysenck's E,N and P constructs, except for the correlation between the child and the parent to whom they were attached. The suggestion which Masqud makes, is that the findings substantiate a hypothesis of Sears (1965), that personality characteristics are the products of the child's identification with his parents. An explanation on such as this is in line with an account of the results in terms of developmentally stable strategies: use as a model, the most significant care giver because in so doing the more significant care of this giver is likely to be 'captured'. There are several reservations that one might make about this specific study, (the homogeneity and size of the sample, and the likely increase in measurement errors using an instrument with English standardisation in Pakistan). However, Masqud's study does provide hints of the type of interaction that might underlie the repeated finding of specific within-family environmental influences as components of the structural equation partitioning total variance (Eysenck 1980, Rowe and Plomin 1981). Within family influences are also implicated in a review by Henderson (1982) who concludes that a simple model for kinship data in the personality domain, incorporating only additive genetic components, and specific environment components does reasonably well in accounting for much of the data.

The specific environment component provides a general area of significant influence for which further research

should provide the processes which can account for such influences. The developmentally stable strategy concept is likely to provide a useful tool for generating hypotheses to account for this source of variation.

II Social Orientation and Processing: Implications for Personality Theory

Another major insight that sociobiology and human ethology can provide, is the way in which patterns of behaviour reflect the genetically encoded strategies for survival as they manifest in the structure of social behaviour. Chance (1980) makes a fundamental distinction between agonistic behaviour modes and hedonistic behaviour modes, the former being characterised by a continuous alertness to danger, whereas the later mode is characterised by an ability to control and direct attention to objects in the environment. Such a differentiation of behavioural modes is correlated in primates with different types of centric society; for predominately agonistic species there is spatial separation (territoriality), with continuous attention to a dominant individual; within predominately hedonist societies, there is close contact and attention is allocated periodically and only to socially central figures in the event of display. Human beings can exist in either response mode, and the suggestion is that prototypic agonistic mode is capable of being agonistically buffered, by behaviours derived from the hedonistic response mode. For example in the human infant, prototypic rejection (by the withdrawal of mother) is capable of being buffered by allotypic influences of other significant care-givers (e.g. being hugged by Uncle and Aunts). Agonistic buffering which Barash (1977) suggests

is the nonhuman equivalent of "don't hit a man with glasses", has been documented by human ethologists (e.g. Irenaus Eibl Fibesfeldt 1980), and has as its most primitive strategy the smile. The insight that Chase provides, is that corresponding to two different types of social relations there are different types of referent relationships, and very likely different processing pathways involved. The formulation provided by Chase received support from the neurophysiological research of Adams (1979) who finds evidence for separate pathways involved in the processing of motivation stimuli as compared with releasing stimuli. There is also a parallel to be found in the distinction that Primbram (1980) makes between processes taking the organism out of motion (emotion), and those processes that result in effective behaviour (motivating).

The convergence of ethological and neurophysiological outlined above relates to the systematic development of personality theory, because it demonstrates the existence of evolved processing modes that should be differentiated in accounting behaviour. It is thus, important because it places considerable constraints on the personality processes that might be used to explain patterns of social interaction. Given a social group, the evidence outlined, suggests that there are good reasons to break the data of behavioural interactions down into interactions where the activated pathways are those of an agonistic nature, versus interactions where the activated pathways are those of a hedonistic nature. For example, one would distinguish between the interactive processes that occur between the child and a very strict teacher, and the child and their very best friend.

While the first situation should (in Chase's scheme), involve agonistic arousal, and the continuous attention to the teacher, the second situation will show (in the absence of distracting stimuli), just as intense attention given to the other person, but here the arousal accompanying and sustaining the interaction will be hedonic. If the agonic-hedonic distinction is valid, (and a recent paper by Fromme and O'Brien (1982) finds some support for the superiority of the ordering of emotions by this model as compared to Plutchik's (1980) model), then it is no longer desirable to equate these behaviours where a purely behavioural analysis seems to reveal similitude.

To illustrate the danger which can arise in ignoring the distinction between agonistic arousal and hedonistic arousal, consider a psychologist who rates a person on a personality attribute such as attentiveness to others. In this case, if because of social circumstances the rated person is less prone to agonic arousal than hedonic arousal, then the consequent, apparent behavioural inconsistency will discourage the further development of the trait 'attentiveness to others'. (Hedonistic arousal is less likely to produce attentiveness to a dominant person than will agonistic arousal.) This example demonstrates how formulating sets of trait behaviours in terms of their everyday definitions can discourage the development of a theory of the ontogenesis and function of this trait in the overall personality structure.

In the light of the above example, there are reservations about Epstein's (1979b, 1983) recent attempt to develop a theory of personality which incorporates a theory of emotion. Such an attempt is well merited, because besides the construct

of anxiety, there is a decided lack of theory which will relate the organisation of the personality, to emotion system characteristics such as emotional lability, dominant emotional tone etc. Unfortunately, Epstein's theory, falls into the abstract system category discussed earlier, in that while he claims to decide upon his primary emotion on the basis of their interspecies commonality and the adaptive advantage bestowed by the emotion, he ignores the ethological research discussed earlier. In doing so he takes the study of emotion and personality away from the biological processes that determine them. There is a grave danger that the formula of accepting as an emotion whatever society defines as an emotion, (which Epstein (1983) emphasises as a practical solution for the determination of what constitutes a secondary emotion) has also been used in the determination of primary emotions. The consequence is that the set of cultural categories for emotions is being used to encode behaviour and be a basic construct of theory. Biological categories, not cultural categories should be the starting point for theory.

Ideally, a theory relating emotion to personality should start without assumptions about what are the fundamental set of emotions. Instead, what is seen as emotion can be regarded as the consequence of complex physiological, cognitive and perceptual determinations on behaviour. These are constructed out of innate processes and produce behaviour patterns that are determined by the learning environment and epigenetic rules that assemble humanly invariant processes and behaviours into culturally varying behavioural and phenomenal complexes. This definition of emotion requires

researchers to search for emotion boundaries, by the usual methods (e.g. expression differentiation, the phenomenology of feeling states, somatic and neural patterns of arousal), but also to relate such states to the emotion invoking environment, and the patterns of social interaction engendering that emotion. The ethological work of Chance and Eibl-Eibesfeldt and the functionalistic approach of Plutchik (1980), by retaining the natural environmental evoking conditions as part of the classification scheme for emotion, promises a valid list of primary emotions, and the benefit of a natural base from which to build a theory of emotion and personality.

Genetic Classifications and Concrete Personality Systems

To this point, we have demonstrated that in terms of building scientific theories, there are a number of costs associated in the deviation from a concrete living system theory, and that researchers in the psychological domains of affect and personality have built their abstract theories in the face of such costs. In this section, it will be argued that one way of ensuring that personality theory is rooted in a concrete theory of living systems, is to evaluate personality constructs with biometrical analysis designed to demonstrate significant inherited components of such constructs. Such an analysis is not meant to be put forward as a conclusive test of the usefulness of a personality construct, but the demonstration of a significant inherited component of the total variation exhibited by persons for a particular personality construct, would be an important source of validation of the construct. Even when such an analysis

produces no evidence that a particular characteristic has any genetic component, and therefore it has no innate biological basis, the analysis answers in very general terms the important question of how the behavioural disposition came into being. (viz In the present case it must have been learnt). The knowledge of how the behaviour related to a personality construct came into being is essential for deciding future research priorities.

The personality theorist, in postulating a set of constructs will have had several goals, among which will be the prediction of ongoing behaviour by the use of these constructs. Thus, it is not necessary that the constructs that a theorist uses be part of the normally accepted constructs of a culture, only that it be predictive and measurable (and ideally have some explanatory power). There are two ways that processes which underlie the construct may originate; they can be learnt or they can be genetically predetermined. Often without a genetic criteria it is difficult in the extreme to differentiate between the genetic basis of a disposition and the environmental basis of a disposition. For example Anderson, Kline and Beasley (1980) argue that there may be a single set of learning processes underlying all learning including language acquisition, and that these and not the special biologically based mechanisms proposed by Chomsky (1957) are responsible for language acquisition.

The implications for the personality theorist of the two different origins of dispositional tendency are quite distinct. While personality processes arising from both kinds of origin may become quite rigid and opposed to change

(as in the example of a tautological belief system), conventional wisdom about the fixedness of genetically encoded characteristics, would recommend that a personologist should accept the non-modifiability of personality dispositions that can be shown to be genetically encoded. The fundamental point though is that the personologist should be able to point towards the specific origin of a personality disposition, in order to be able to build an integrated theory of personality. The identification of a disposition as genetically encoded, then permits the theory development to proceed towards placing the behavioural disposition into a sociobiological and evolutionary context. The lack of a genetic origin demands that the specific life course developmental strategy and environment sequence that has been responsible for the behavioural disposition be plotted. Too much personality theory has not found it necessary to pinpoint the origins of the personality structures thought to underlie behaviour, and have opted to attribute the behaviours to social learning (e.g. Mischel, 1976; Bandura, 1969).

The fact that social learning can influence behaviour, is not to be disputed, and is very important when it comes to a theory of therapeutic intervention. However, formulating the explanation of a particular behaviour in terms of social learning theory, and demonstrating the efficacy of the social learning process, is not tantamount to the scientific validation of the social learning theory explanation of a behavioural disposition. The research is flawed and inconclusive on two counts; firstly because social learning theory with its behaviourist legacy does not explain

dispositions, rather only discreet behavioural acts; secondly because the demonstration that social learning processes occur, is not the same as a proof that social learning processes underlie the behaviour that the personologist wants to explain (at the time and situation). As an example of these reservations, consider the experiment in the delay of gratification conducted by Bandura (1965), which showed that a live model who delayed gratification, produced a similar delay of gratification in children who observed his/her behaviour. Clearly, such a demonstration merely addresses itself to the plausibility of the social learning explanation of other instances of delay of gratification. Ultimately it must be evaluated in terms of the extent to which all instances of delay of gratification may be explained in terms of the hypothesised social learning processes. Of course a biometrical analysis which indicates that a behavioural disposition is largely inherited, does not exempt the personality theorist from the analysis of the environment necessary for the ontogenesis of the inherited tendency in behaviour. It should however terminate any attempt to find the cause of behavioural differences solely in the learning histories of the subjects being studied.

It is clear then that biometric analysis is an important tool for ensuring that the right level of explanation is utilised for explaining personality constructs. By differentiating between those constructs which are derived from genetic determinants (given appropriate developmental environments), and constructs which are derived from environmental determinants (given genetically determined information processing structures), the analysis ensures

that the explanation of personality remains linked to the explanational nexus of other levels of the concrete system. However, biometrical analysis in itself is not sufficient to ensure that the lines of cleavage of the concrete system are adhered to, and the problems and solutions to these problems are considered next.

Biometrics and Personality Factors

Typically, in human behavioural genetics, biometric analysis yields a coefficient of heritability on some trait or attribute, and divides the rest of the variance into that which is purely environmentally determined and that which is a result of the interaction of environmental and genetic influences. However, obviously it is possible to take any measurement of a personality construct, and subject it to biometrical analysis; the analysis does not guarantee the usefulness of the construct. This problem of what constitutes a useful classification of organismic attributes has recently been considered by behavioural geneticists. The solution would be simple, if each gene controlled a single behavioural expression, but as is pointed out by Fuller (1979), a change at a single locus is capable of influencing a wide range of behaviours, whilst a variation of a polygenic system may influence only a small part of the behavioural repertoire. Fuller, in light of these considerations, advocates regarding factors as real, and accepting that these inferred psychophenes will be useful in the study of genetically determined behavioural organisation.

Henderson (1979) identifies several levels at which genes can act, and suggests that in the case of animal

experimentation most research has been pitched at the level of 'characters' (such as open field ambulation, brightness discrimination etc), and that this might be the least appropriate level to operate if the object is to understand natural selection and behaviour. Henderson advocates the use of factor analysis at the level of characters, and a comparison between the results of a genetic analysis of characters with those of a genetic analysis of 'super characters' (factor scores). If there is a factor, that can be considered sufficiently essential to survival, to be genetically encoded, then Henderson suggests that the status of such a factor can be detected by the fact that its ratio of variance accounted for by dominance ¹ effects, to the ratio of variance accounted for by additive effects, will be larger for a composite factor measure, than that ratio for the individual items. Henderson points out that there will be factors related to the structure of the organism as a manifestation of its evolution reflecting genetic code, and other factors relating to the significance of its structure to the laboratory environment. The dominance ratio test proposed is a rule of thumb to distinguish between the two kinds of factors, and its necessity highlights the fact that in terms of genetic research through biometric analysis, it is not sufficient to rely on procedures such as factor analysis to obtain organismically informative constructs. Extensive

¹ The estimation of additive and dominance variance involves respectively using the mean of parent scores to predict offspring scores versus using the highest scoring parents score to predict offspring scores.

validation of the factors must also be performed in order to distinguish evolutionarily significant processes.

As well as the variance ratio test of the evolutionary significance of a construct, there are a number of other methods proposed by behavioural geneticists. These include the correlation between viability and a characteristic selected for (e.g. Broadhurst (1970), the analysis of genetic correlation¹ matrices for factors (Fulker 1979; De Fries, Kuse and Vandenberg 1979), and the separate factor analysis of test items that show a maximal rmz - rdz difference (Loehlin 1965). These tests of evolutionary significance of behavioural traits are important to the present discussion, because they highlight a paradox of the use of personality inventories. The paradox is that such inventories when derived by the consideration of factors that maximise the explained variance, result in the emergence of dimensions of maximal variation, that while they may be expected to exhibit high heritabilities, are also most unlikely to have been subject to much selection pressure, and consequently are likely to be incidental aspects of the organism.

The present approach to the study of personality using inventories of objective test items, is to select from an initial item pool those items that load highly on the factors that account for the largest amount of variance (e.g. Eysenck 1969, Cattell 1977). This practice, has many pitfalls as

¹ The genetic correlation between two scores, is the correlation between the genetically determined components of the scores.

The formula is
$$r_a = \frac{(\text{cov}P_x P_y')(\text{cov}P_y P_x')}{\text{cov}(P_x P_x') \text{cov}(P_y P_y')}$$
 where P are the phenotypic scores. Unprimed are offspring, primed are parent.

pointed out by Cattell (1973), including the danger of replacing broad factors by what Cattell refers to as 'bloated specifics'. This danger is a consequence of a biased sampling of life areas in the preparation of the psychometric instrument, and its results in the occurrence of instrument specific factors much akin to the laboratory specific factors discussed earlier. As well as factors emerging that are specific to the measuring instrument, frequently used non exhaustive orthogonal factor analyses are likely to result in the emergence of pseudo-second order factors, which Cattell (1973) argues is the case for the Eysenck questionnaire. Thus the unreflective use of factor analysis in itself is no guarantee of parsing the collection of constructs that we use into those that reflect biological lines of organism, even when we perform the factoring on the genetic correlation matrix as suggested by Fulker (1979) and De Fries et.al. (1979).

How should we interpret estimates of heritability of the range .4 to .75 for the personality traits in the studies reviewed by Henderson (1982)? There is an obvious inclination to allow the statistical significance of the heritability estimates argue for the biological significance of the behaviours being reviewed. Unfortunately, high heritabilities are neither sufficient to establish the biological significance of the behaviour considered, nor are high heritabilities necessary for biological significance. The non sufficiency follows from the fact that substantial heritabilities are often found in traits that are irrelevant to survival. For instance, Von Schilcher (1982) points out that the amount of white spotting in Fresien cattle is highly heritable,

because it has not been subject to selection pressure, and has little biological significance. The lack of necessity is a consequence of the fact that there are many genetically determined characteristics that do not exhibit a range of alleles. Directional selection has (for all purposes), removed genetic variation in these attributes. This kind of attribute with a specific allelic optima can be exemplified by traits such as conception rate where the directional selection associated with a beneficial allele rapidly ensures universality throughout the genepool.

Given then that high heritabilities do not of themselves allow the dissection of significant dimensions of personality, what is to be made of the heritability coefficient? The best that can be made of it would be that it can be used to obtain a measure of the innateness or otherwise (open program or closed program) of these personality dimensions via a formula such as

$$h^2 = \frac{V_g}{V_g + V_e \left(\frac{1}{I} - 1 \right)} \quad \text{Jacobs (1980).}$$

Where I is a coefficient of innateness. Such a utilisation of the hereditary coefficient is not trivial, because as mentioned earlier it constrains the theories of the development of behaviour into formulations in terms of epigenetic rules, and these in terms of learning occurring via environmental interactions. Significant advances are made in understanding processes underlying behavioural trait formation once a general locus of behavioural variation can be identified (e.g. Rowe and Plomin 1981).

We are still left with the question of - given the trait extraversion-introversion, should we dispose of it in the

same way as we dispose of other "genetic junk" (Theissen 1972). Alternatively should we regard it as an example of stabilising selection which favours the average phenotype at the expense of more extreme phenotypes? The answer will depend on the result of convergent evidence of to what extent the behavioural complexes described and measured by the trait instrument amount to be more than "bumps on the head", and have very real consequences for social organisation, group harmony and individual integration. The likelihood is that if behavioural complexes which have such consequences are found, then there will also be evidence of genetic codes influencing the behaviour. In as much as the example we have been discussing has received considerable convergent validation (e.g. Eysenck 1969, 1977, 1979, 1980), then we can regard it as an example of stabilising selection, and should retain it as a significant component of personality.

There are other examples of personality constructs that one would be less inclined to retain, in spite of a relatively high degree of genetic determination. For instance the Premia-Harria dimension of the 16PF (Cattell 1973), is purported to have a heritability of about .60, but it is unclear precisely how this trait relates to biological determinants or to selection pressures. The possibility is that this trait is a trait deriving its reality not from the pattern of organisation in the observed, but rather from the categorising tendencies of the observer. If the biological validation of Premia-Harria proves to be intractable, then the construct might be retained for social and organisational purposes such as selection, but it should not be retained as a fundamental construct for the purpose of personality

theory. Instead, the organisation of personality processes that underlie the genetic stability of the Premsia-Harria dimension should be approached through a reduction to more fundamental dimensions of personality processes, and their effects on the Premsia-Harria dimension.

Non Selected Traits

So far, in contrasting Introversion-Extraversion with Premsia-Harria as dimensions of personality, it has been suggested that if there is evidence of stabilising selection then we should admit the construct as a desirable element in a theory of personality. It is not always possible though, to put forward arguments that a particular characteristic has been subject to selection pressures. This raises the question of whether strict adherence to identifying the biological processes that underlie personality characteristics, will result in an impoverished theory of personality incapable of explaining in detail the complex patterns of interpersonal communication and action that is characteristic of homo sapiens. To get around this difficulty, it must be allowed that the taxonomy of personality processes which is subscribed to, include processes peculiar to a particular environment and which have not themselves been the subject of a significant degree of natural selection. For example, the trait of punctuality might be put forward as an example that is unlikely to have been subject to selection pressures, and yet contains a significant quality of the consistency that individual's show in their behaviours across situations or times. This trait of punctuality, while it is likely to have been subject to minimal selection

pressure, will still quite possibly exhibit a significant heritability related as it is likely to be to the Cattellian trait of desurgency (Cattell 1973), which shows a heritability of .6. The personologist in developing a taxonomy of individuals, is likely to want to include the descriptor of punctuality, because this construct is significant to individuals in terms of their self concept. Punctuality is also significant to others interacting with the individual, because it is a component of many socially prescribed roles. So, because the personologist is developing a theory to meet the needs of the individual and of society for an account of personal actions it is desirable that the theoretical language used, is capable of retaining those questions which first gave rise to the press for a theory.

Therefore, a trait such as punctuality might well be regarded as a useful construct to add to the technical language of the personologist but, to avoid a plethora of convenient constructs eliminating the parsimony of personality theory, it is necessary to impose side conditions on the constructs which will form the basis of personality theory. The position being developed here, argues that as well as having explanatory utility on a social level, personality constructs must be validated by tying their dimensions to underlying biologically determined processing structures, which in interaction with the developmental environment, provide the motor for the personality invariances that are noted. Thus, for the example of punctuality, a full validation might require its integration into the extant theory of self monitoring (e.g. Snyder, 1979) and elucidation of the attention processes that underlie self

monitoring, as well as the description of the developmental environment, that will bias the degree of temporal self monitoring in the direction of punctuality.

Validation of Traits

Such an extensive validation of a personality concept is necessary in order that an adherence to the lines of concrete system be maintained. Alternative, and less complete forms of validation such as behaviourism's relation of behaviour to the learning environment, or a total genetic reductionism to biological structures, are inadequate on two counts. Firstly, either partial validation is likely to omit certain emergent personality phenomena from the coverage provided by a validated theory; the example of punctuality is likely to be omitted using only biological structure correspondences as a validation method, and for introversion-extroversion, purely environmental validation is likely to result in the omission of this very important personality construct. The second consequence of using only one of the two means of validating a construct, is that when used alone, either of the validation criteria discussed here are likely to be misleading in distinguishing core personality tendencies from peripheral personality tendencies. Used separately, the identification of learning history, or identification of biological structures produces descriptions of the antecedents necessary for the occurrence of stable processes. However, stability of processes, is only one characteristic of core tendencies, the critical characteristic is the ubiquity of core tendencies as determinants of peripheral tendencies. In order to differentiate between the construct set associated

with core tendencies and the construct set associated with peripheral tendencies, it is necessary to demonstrate that peripheral tendencies arise as the product of the interplay between core tendencies, and unique historical and genetic factors of the individual. The rule of thumb that differentiates core tendencies from peripheral tendencies, will be the extent that the one validated construct is a necessary component of the validation of other personality constructs.

Consider again the example of introversion-extroversion. Here the biological validation of the construct has taken the form of a demonstration of the basis of the dimension of individual differences being the level of cortical arousal (e.g. Eysenck, 1977). This core construct underlies a number of peripheral constructs such as sociability, and even aesthetic preferences (Eysenck, 1941). In order fully to account for the peripheral constructs, the core construct in interaction with other factors will be needed. The problem with restriction of validation is that in a number of cases, the pervasiveness of the influence of a single construct can not be assessed by a sampling from only one of the domains of validation. For example, a biological structure may have a considerable influence on the functioning of other biological structures that mediate learning and hence for the resolution of many emergent dimensions of personality.

Philosophical Justification of Validation

What is being advocated here for the field of personality is very similar to the approach to science advocated by proponents of the philosophical school of transcendental realism (Bhaskar 1979). This approach to science is an alternative to empiricist epistemology and the paradigmatic approach of Kuhn (1970). It is characterised by the acceptance of levels of emergent phenomena which are dependant on the existence of a particular causal structure which it is the scientist's task to uncover. This philosophy of science stresses the fact that "Scientific explanation is not subsumption" (Manicas & Secord 1983, p.402), and opts for an analysis of scientific laws that bestows the status of law not on merely conjoined events, but on causal structures that underlie (sometimes) the conjoining of events. This formulation of the criterion for law corresponds very closely to the validation formula in the case of the identification of personality constructs which has just been discussed. Among the necessary conditions of lawfulness, is that "...one must have a theoretical understanding of the nature of the structure such that one can specify the conditions under which the dispositional property will not be realised." This bears a parallel to what Weinberg (1975) in setting forth general systems thinking refers to as the count to three principle: if you cannot think of three ways of abusing a tool you do not know how to use it. There is thus a convergence evident between the formulations of general systems theory, the transcendental realist philosophy of science, and the conclusions which have been arrived at in this chapter on the means to ensure that personality

theory develops along the path of concrete system theory. The common conclusion is that in order for scientific explanation to occur, phenomena have to be embedded in the causal structure that gives rise to them. (It must be emphasised that this is not tantamount to a strict determinism, because of the acknowledgement that a strict deterministic explanation is unobtainable in our world of open systems.)

The discussion to date has indicated desirable properties that a coherent theory of personality should have, such as the adherence to the concrete system via an emphasis on the causal structures that underlie personality dispositions, but it has not yet looked at a specific program that will allow the study of personality within these guidelines. It has been suggested that an ordering of behavioural importance is necessary in order that personality theory envelopes those behaviours that are indicators of personal functioning, and that those behaviours although frequent and regular that do not contribute to personal functioning are excluded. (An example of these later incidental behaviours might be ear lobe tugging behaviour.) It has also been argued that in order that the personality constructs which are utilised for the purposes of explanation, have a close adherence to the concrete system (that is the organism), that personality constructs be related to the organisation of their causative factors. The causative factors in the case of personality phenomena are likely to be biological structures, processing pathways and the learning environment (which can modify stimulus representations and processing pathways). It is thus argued that the validation of a personality construct must involve an identification of the microprocesses that

are contributors to its manifestation in behaviour. The next section will examine a possible strategy for the development of a powerful personality theory.

The situation facing the personologist developing a theory of personal dispositions is much akin to that of the ethologist who searches for the invariant sequences of behaviour that underlie more complex behavioural sequences in order that phylogenetic comparisons might be made, and the specific genetically coded behaviour adaptations of a species may be traced. Just as if the ethologist chooses too gross a level at which to derive the ethogram, then there will be a lack of distinguishing characteristics between species (as the case of the orienting reflex discussed earlier demonstrated), so also the personologist looks to break the units of investigation down into a level of detail that allow differentiation between persons in terms of minimal integral units. Underlying such minimal integral units will be processes and structures, either innate, or learnt that give rise to the units of personality. Thus the program which is envisaged, would be for a cognitive ethology which would include a number of fixed processing patterns that would be used to account for patterns of personality. A call for a cognitive ethology has already been made by Meichenbaum (1980) who envisages such a science as a set of procedures to capture the flow of cognitions, affects, and behaviours. The cognitive ethology advanced here goes further than that proposed by Meichenbaum because it requires more than an expression of the patterns of cognitions, affects and behaviours that correlate with personality types, it also requires an account of the processes that underlie the

characteristic cognitions. This requirement has the considerable virtue of ensuring that the causal conditions of personality are not found amongst those same characteristics that identify personality. Since cognitions in the form of utterances or behaviour are the data of personality categorisation, the requirement fulfills the function of validating traits through a deeper level of theory.

Useful candidates for processes that result in human personality should demonstrate a fixidity (automaticity), as with fixed action patterns within the individual, and should be amongst the set of processes that are used in a wide range of information processing in normal individual-environment interactions. By fulfilling the above two conditions, the subprocesses (henceforth referred to as microprocesses after Posner (1978)), will be capable of explaining those apparent behavioural rigidities in important areas of life that have traditionally been ascribed to personality traits. It is fundamental to much of science, that emergent phenomena be classified with the aid of a knowledge of subprocesses that contribute to the phenomena, rather than purely in a gestalt manner. An example that perhaps parallels the situation of the personality theorist in that much of the theory must derive from non interventional observation, is that of the cosmologist. Here, a knowledge of subprocesses such as the effects of doppler shift on the observed frequencies of radiation, form an inference set whereby sense may be made of the form that the physical universe now takes. Just so, in the case of the normal emergence of personality phenomena in the course of social interaction: a personality theory requires a set of microprocesses that

can be assumed to underlie the observed behaviour patterns, form a causal framework with which to classify events, and which will admit naturally occurring behaviour in the study of personality. Such an approach is in line with the suggestion of Manicas and Second (1983) that explanation and prediction are not symmetrical, and that it is a valid exercise to ascribe causation to a nonpredictable interaction.

This approach promises to mend the split between the two major methods in the development of personality theory; the clinical approach and the experimental approach. Both of these traditional approaches, used exclusively have limitations - one does not have a ready means of identifying fundamental processes that underlie observations, and the other does not embrace the full data base of personality interactions confined as it is to the closed system of the laboratory. The blending of these traditional approaches that is advocated here promises a more comprehensive personality theory.

Are Emotions Microprocesses?

A clue as to which microprocesses might be employed to account for personality comes from the work of Plutchik (1967, 1980), Plutchik and Schaeffer (1966), and Conte (1975). The series of studies reported in these papers demonstrate that personality terms appear to conform to the circumplex model of the primary emotions. Plutchik goes as far as suggesting that "In fact all personality traits, when defined in terms of interpersonal relations, can be conceptualized as resulting from the mixing of emotions." (Plutchik 1980 , p.55). This then suggests that personality

differences may be a consequence of the characteristic level of the fundamental emotions within the individual, or as a consequence of the person attempting to maintain a characteristic level of input at the emotional level of a hierarchical control system as is suggested by Powers (1973, 1978).

Heise (1979) has approached the analysis of social situations and social roles using a control system model. His framework analyses the affective transients elicited by situations, and considers that events are structured via behaviours that take the form of plans and actions designed to return immediate feelings back to established or characteristic sentiments. The approach has been applied with some success to a wide range of behaviours including role analysis of courtroom, religious, university interactions.

A problem with Heise's analysis is that it works with a limited set of affective dimensions furnished by the semantic differential. Thus, his analysis while reasonably predictive, in working within such a restricted state set

does not provide a validated state construct. What the analysis achieves is the substitution of inferred states for the usual personality descriptors of inferred traits. However, the processes that underlie the states are not defined, and the theory would seem to be utilising the semantic differential as a state measure for its measurement convenience rather than its theoretical usefulness. The major advantage of the state approach via the semantic differential compared to traditional trait approach, is that it is useful for characterising situations. But, while characterisation of the situation is important to personality theory (e.g. Bem 1982), a theory of the psychological processes that mediate between situation and state would seem to be necessary for this approach to carry more power than ordinary trait theories.

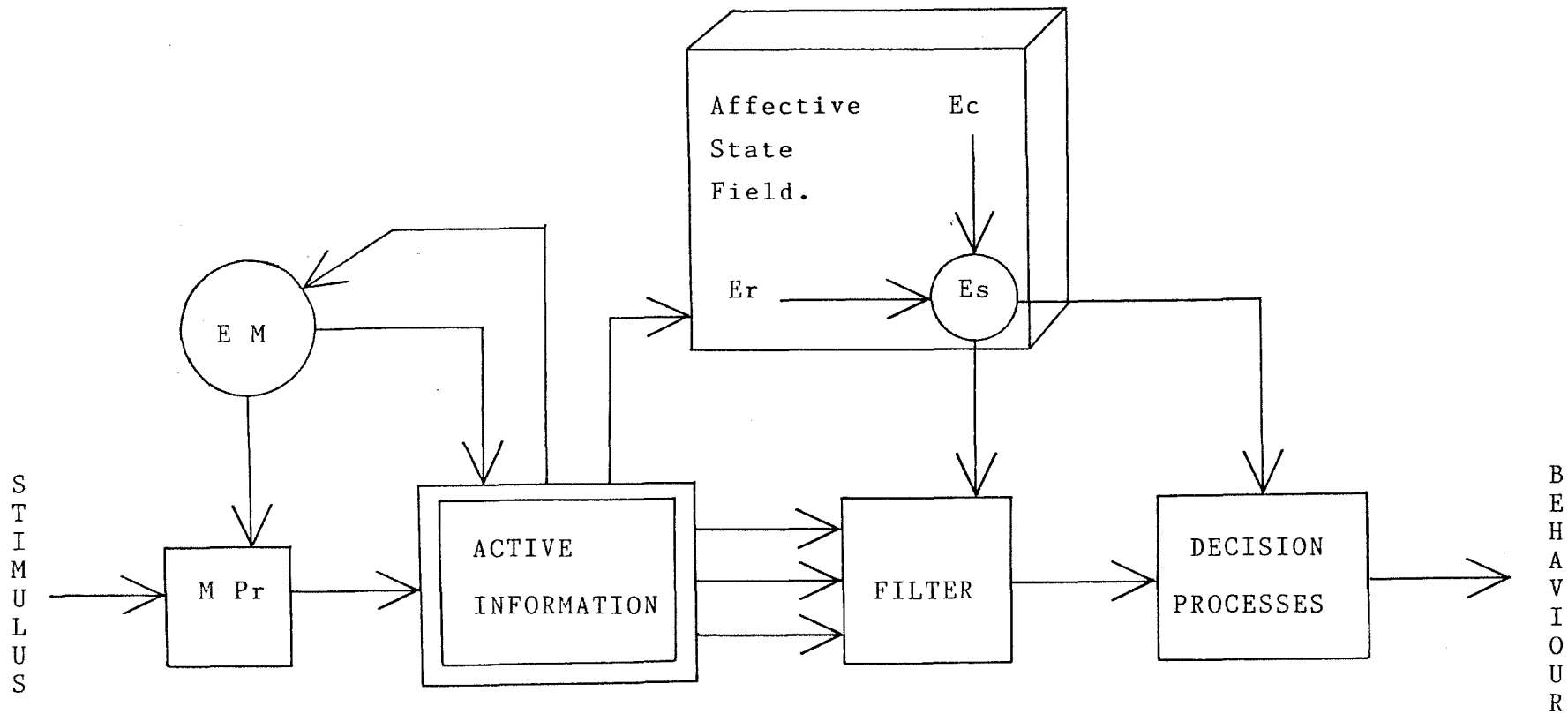
The close relationship between emotion and personality suggested by Plutchik, and the suggestion that the person acts in accordance with maintaining emotion by Heise, point to the potential of developing a theory of personality via the analysis of emotional processes. Unfortunately it is not very easy to work out the personality-emotional process rules. This is because, just what is the best way to define an emotional state is extremely problematic. Plutchik (1980) has noted that emotion is not a subjective experience per se, but is rather a hypothetical state whose existence is inferred on the basis of a number of lines of evidence. Thus, while we might agree with Hebb (1946) that the subjective naming of emotional feelings is necessarily more accurate than the naming of the state by outside observers, nevertheless working at the level of gross emotion is beset

by measurement and definitional problems. It might be better to analyse emotions into more primitive components which can be studied within an information processing paradigm, and use these components as theoretical constructs in the development of personality theory.

The Microprocess Assembly Model of Personality and Emotion

The way in which emotion might interact with cognition in producing behaviour is depicted in figure 4-1. Figure 4-1(a) is a full model of the way in which microprocess produced transformations, and mutually influencing subsystems might account for a person's behaviour in a particular situation. The model is not detailed, but it bears enough similarity to other flow diagrams produced by emotion theorists (e.g. Plutchik 1980, Fig 1.1, p.15; Leventhal 1979, Fig 5, p.16), to claim that it does not misrepresent current thinking on the interactions between emotion and information processing. The full model has been dissected into two partial models in figures 4-1(b) and 4-1(c). The two partial models can be thought of as two different research heuristics which might be adopted by personality researchers. The emotion characteristics model Fig 4-1(b) emphasises the influences of affective states on the decision processes that mediate situations and behaviour. It is exemplified by the kind of role analysis done by Heise (detailed above), where for his model decisions were made in an attempt to maintain patterns of characteristic sentiment. The microprocess assembly model Fig 4-1(c) places emphasis on the pathways that transfer and transform

FIGURE (2-1) THE FULL MICROPROCESS ASSEMBLY MODEL.



Affective state field = Grey box ,composed of known stimulus-state transform rules ,but an unknown mechanism determining these. E M = Emotional Memory. M Pr = Microprocesses operating automatically on input. Er = Emotional transient to new input. Ec = Characteristic emotional setpoint. Es = Momentary emotional state.

FIGURE (2-1b) THE EMOTION CHARACTERISTICS SUBMODEL.

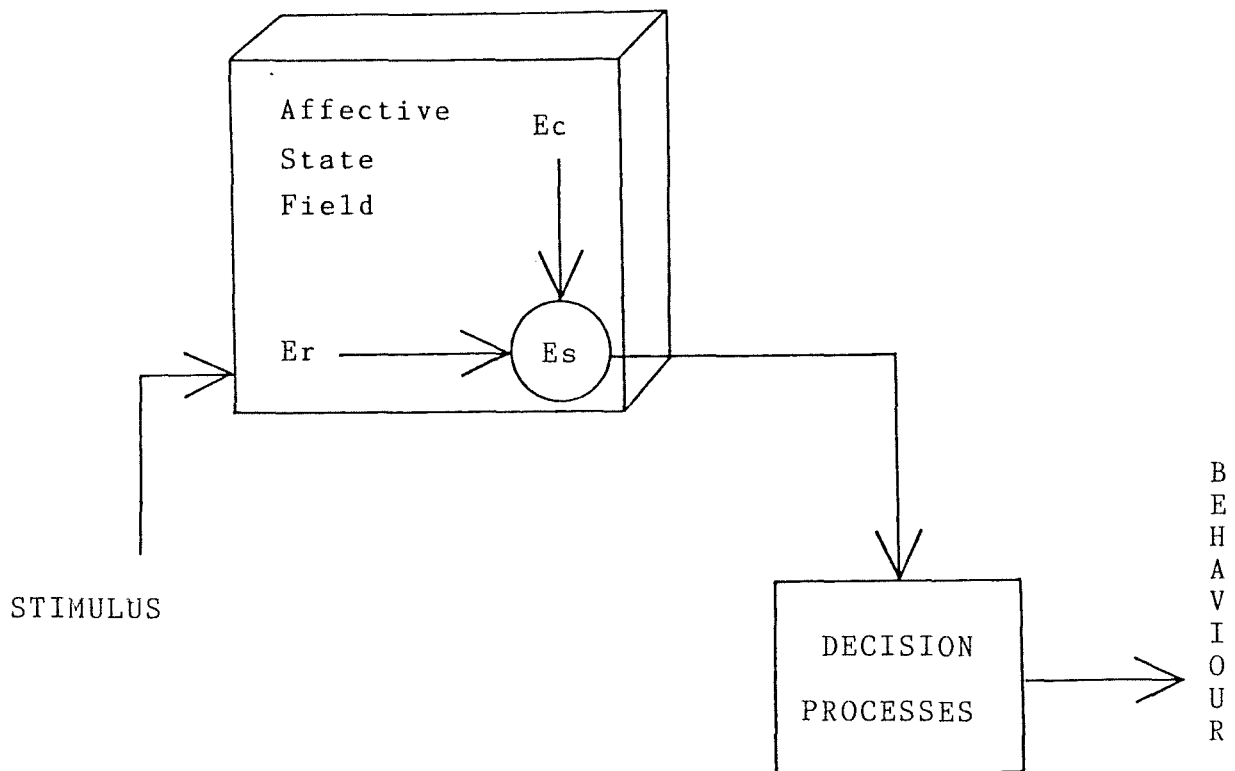
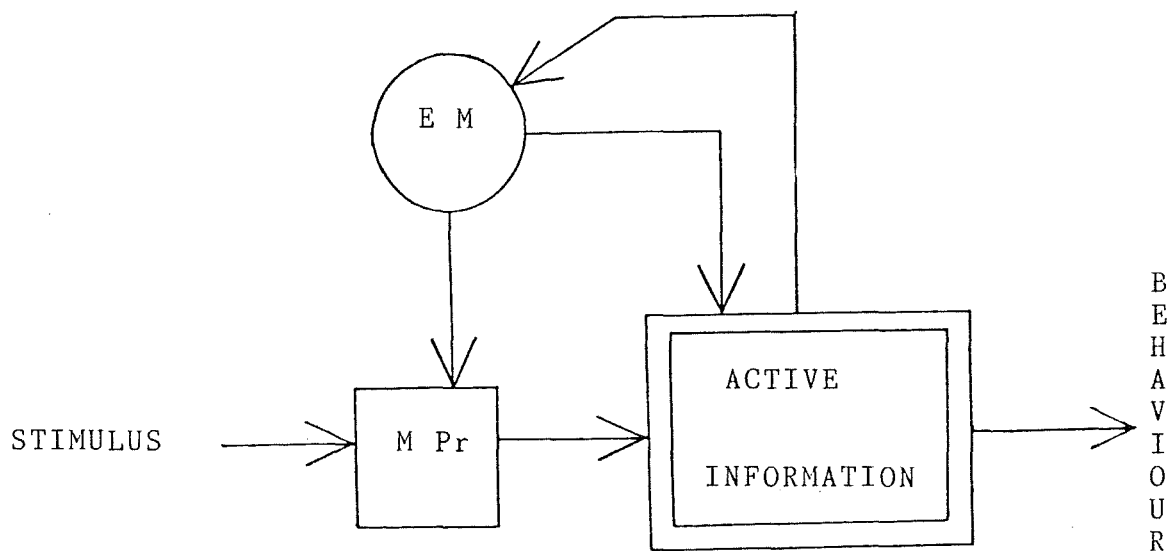


FIGURE (2-1c) THE MICROPROCESS ASSEMBLY SUBMODEL.



information as determinants of behavioural organisation. Thus, the microprocess assembly model emphasises the active representation of a situation as the major factor in a person's behaviour, and seeks to explain personality differences in terms of the processes that lead to the active representation.

The two models 4-1(b) and 4-1(c) are not mutually exclusive, but represent two different focuses on the one system. Both models will most likely be needed for a full account of human personality but it will be argued here that the microprocess assembly model of figure 4-1(c) is the most useful one to adopt as a research strategy at this point of knowledge.

The microprocess assembly model is somewhat of a departure from classic interpretations of personality. Classic theories of personality do have processes put forward as part of the theory, but processes are core characteristics of the theories and are assumed common to all persons. The assembly model differs in that it asserts that differences in process are sources of differences in representational structure, and hence give rise to personality differences. In contrast, the structure and process distinction used by traditional personality theorists have tended to emphasise processes as principles that underlie all behaviour, but need to be conjuncted with environmental factors in order to explain variations in personality. Pervin (1975) for instance uses conscience as an example of structure, and the guilt that results as an example of process; thus, process accounts will show that human behaviour is partly oriented to minimising guilt, but ultimately the source of

variation stems from different levels of conscience. The microprocess assembly model makes the explanation of situationally manifested behaviours by recourse to the operation of microprocess assemblies unique to the individual. (It is only the assemblies of microprocesses that are unique to the individual, as the microprocesses themselves are taken to be a set fundamental to all emotional experience.)

It is acknowledged that a large amount of variation within the population which has been used to describe the 'personality' of people cannot be explained in detail by a microprocesses assembly theory. The microprocesses assembly theory's range of convenience is only those personality attributes that are biophysical in nature, and that derive their character from genetically determined characteristics. Totally environmentally imposed characteristics which are also very important for predicting a person's behaviour and in the biosocial characteristics of the person are not accountable in terms of the restricted microprocess assembly model alone. A more comprehensive theory of the person which integrates the approach here with a theory of how learning sequences can give rise to enduring processing structures (e.g. Anderson, 1983) would be an ultimate objective.

Microprocesses and Microprocess Assemblies

Before a more detailed examination of the nature of the microprocesses which could manifest as personality, it should be made clear what the criteria are for categorising a microprocess as genetically determined. Obviously a low hereditary coefficient (such as is enjoyed by the characteristic

of the number of fingers in one hand) may either indicate that the trait is varying according to environment, or is of such importance that it is dependent on a genetically encoded structure common to all people. Since the theory developed here is predefined to be based on information processing characteristics of emotional states, it is to be expected that such processes are found in all people. Furthermore, the kind of selection that is likely to be favoured is that of stabilising selection. Wilson (1975) gives as examples of stabilising selection based characteristics: aggressive behaviour, dominance systems and sexual behaviour. All of these characteristics are of a kind that are much akin to emotion and therefore it is likely that the forces that favour stabilising selection for the above characteristics, will also favour stabilising selection for the microprocesses of emotion. Accordingly the kind of genetic determinism expected of the microprocesses involved in personality and emotion is to be expected to manifest as moderate to large hereditary estimates in accordance with stabilising selection. Thus, it is suggested that an important step in the validation of a microprocess construct, would be to investigate the extent to which it is an inherited characteristic.

The genetic determination criteria of a microprocess should not be taken as suggesting that this requires a high genetic determination of the microprocess assembly. Since a microprocess assembly can be formulated simplistically as a hierarchy of microprocess operations called into play in processing input, the microprocesses themselves can be genetically determined without necessitating that the

heirarchy also be determined this way. The microprocesses can be viewed as a set of available information transforming operations, and the level of importance which they receive will correspond to the extent that cognitive resource is allocated to their outputs. The control process or meta-components (Sternberg 1983) which allocate cognitive resource are the means whereby assemblies are implemented, and these are likely to be partially created out of the learning experiences of the person. That is, microprocess assemblies are the consequence of sequential resource allocation strategies, that by determining the characteristic sequence that the information from fundamental emotion relevant microprocesses is used, influence the personality characteristics of the person. While resource allocation is put forward here as the mechanism whereby assemblies are implemented, this idea is somewhat speculative. Logan (1978) has put forward a similar idea. His preparation model for character classification tasks, suggests that elementary processes involved in the tasks, are joined by the allocation of attentional resource. The possibility that assemblies are created by the allocation of limited cognitive resource to the outputs of automatic processes would seem to be an elegant way of conceptualising assemblies and is consistent with the pervasive influence across situations that personality is considered to exhibit.

As well as a mechanism for the integration of the outputs of automatic processes into an activated representation, the theory put forward here should have plausible microprocess candidates. Unfortunately since almost all of the research into emotion and personality has followed trait based theories,

there is no set of microprocesses detailed. Within cognitive psychology, Sternberg (1983) has developed a componential approach to intelligence and details many component operations that have been found for different types of reasoning. Rose (1980) surveys a wide range of cognitive tasks for inclusion in an information processing test battery and lists eight operations which are sufficient to describe the processing requirements of the tasks. Frederikson (1980) also describes a series of operations in his component skills model of reading. These microprocesses are useful in describing the operating of cold cognitions, but in as much as they tend not to include mechanisms of information choice (as versus information recoding), it seems likely that the set is not adequate to a description of the evaluative function of emotion.

It is part of the research objectives incorporated in this thesis to make some initial explorations in the identification of the microprocesses of emotion.

Implications of the Model for Personality Research

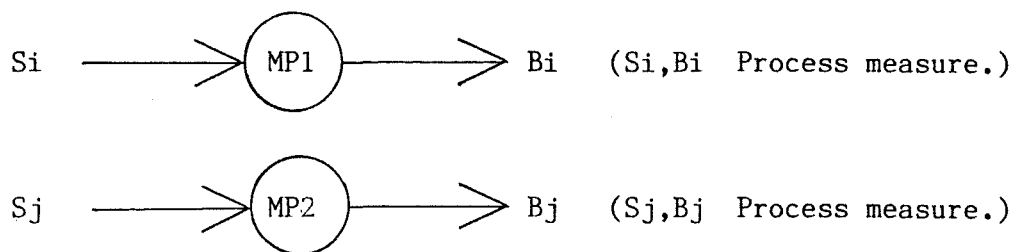
Before comparing this approach to the study of personality and emotion with extant approaches, it is worth noting that the form that explanation takes under the microprocess assembly model, differs considerably from that used in the major theories of personality. The fundamental difference between this model and a theory such as Cattell's factor theory, (e.g. Cattell, 1977) or Allport's conception of traits (e.g. Allport 1966) and dispositions, is that the present model proposes that a demonstration of the representational equivalence of stimuli (and thus their

functional equivalence to the individual), is irrelevant to the development of personality theory. Thus, the present model does not imply as 'the method of personality research', the finding of a correlative response structure to a particular set of items or stimuli. Instead, the present framework emphasises the necessity to demonstrate the sensitivity of a stimulus item to the emotional state of the individual. Part of the item validation procedure envisaged by the model, is to demonstrate a process related change in response patterns (be they reaction time measures or more contentful measures) as a consequence of the emotional state of the individual. So, the present model queries the founding of most factor models of personality in a series of reliably obtained item scores that all load on the same underlying factor, and that all originate from the description of invariant behavioural dispositions.

Figure 2-2, demonstrates how the linkage between emotion related microprocesses, and personality characteristics proposed by the model, means that changing emotional states so as to identify whether a measurement procedure is sensitive to such a change, is fundamental to the identification of the relevant microprocess set. Thus, the present model suggests a method of analysis which firstly starts with a process set with well defined operations; secondly submits such a process set to an analysis of the emotion state dependency of the operations; thirdly uses those operations that are emotion affected, and genetically determined to describe persons and generalise from such descriptions to a theory of personality.

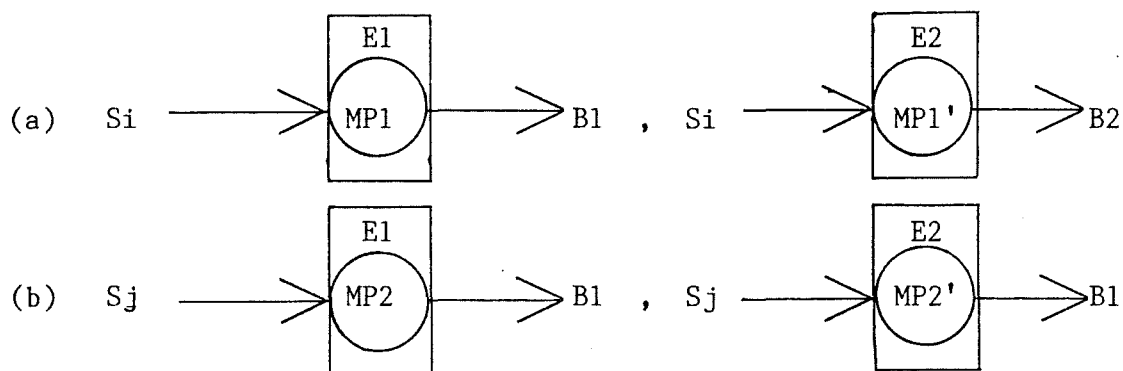
FIGURE (2-2)
METHODOLOGY OF PERSONALITY RESEARCH FOR THE
MICROPROCESS ASSEMBLY MODEL.

Step I: Obtain a process set.



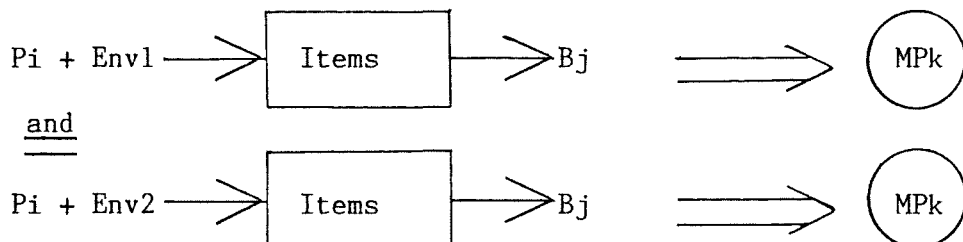
Note that MP1, MP2 are sets of assembled microprocesses that are unlikely to contain totally exclusive elements. That is, there is overlap between the microprocesses measured by the items.

Step II: Retain the items that are sensitive to affect manipulations.



That is, reject the most 'reliable' items which are not influenced by affect. (Reject (b) in the example above.)

Step III: Use the retained microprocess items to characterise the person. That is, if -



Then person P_i is characterised by microprocess assembly MPk .

(Note : S = Stimulus conditions, B = Behaviours, E = Emotional states,
 MP = Microprocess assemblies, Env = Testing/Life environments.)

Personality and Temperament are not Separable

It should be appreciated that the method of theory construction outlined above is put forward as a method of developing a theory of personality, and not just a theory of temperament. Temperament as defined by Allport "...refers to the characteristic phenomena of an individuals emotional nature, including his susceptibility to emotional stimulation, his customary strength and speed of response, the quality of his prevailing mood, and all peculiarities of fluctuation and intensity in mood; these phenomena being regarded as dependent upon constitutional make-up, and therefore largely hereditary in origin." (Allport 1961, p.34). It is an assumption of the present approach, that the distinction between temperament factors and acquired characteristics is one that falsely dichotomises heredity and environment. If as is suggested by Wilson and Lumbsden (1981), 'learning can be regarded as cognitive epigenesis within and beyond the womb' (p.303), then provided theory addresses the level at which epigenesis effects are occurring, temperament will not easily be seperable from contentful personality dispositions. Wilson and Lumbsden also suggest that human beings have primary and secondary epigenetic rules, and the latter are characterised by setting the evaluative and decision making functions by which culturgens (a culturally transmitted information package) are decided on. So, while the microprocess assembly model will have to allow learning theorists to account for the development of very specific behavioural consistencies, it is at a more general level of general affective orientation and its pervasive influence on decision making (e.g. Johnson &

Tversky, 1983; Schwarz and Clore, 1983), that epigenesis occurs.

The influence of emotional states on the patterns of attachment behaviour emitted by very young children supports the proposition that the development of traits via environmental experiences is inseparable from temperament factors. Gaensbauer and Connell (1983) have recently demonstrated that the influence of current emotional state in children determines attachment behaviour in successive episodes. They also found a greater degree of temporal stability in emotional states between comparable episodes than for attachment behaviours between comparable episodes. The research indicates one mechanism whereby temperament factors can play a major influence in the determination of personal characteristics: characteristic emotional states determine which situations the infant emits attachment behaviours in, and thus has an influence on the early experience of person-person are relationships. This means that it might be stated that temperament factors influence the early interpersonal experiences of the infant. It is these early experiences which are seen as critical by many developmental and personality researchers. The research by Gaensbauer and Connell also shows that patterns of emotion are situation specific. This means that early affect-situation covariances are likely to set the kind of predominant interactions that will occur within a situation.

Izard (1979) also discussed the manner in which the emotional expression of the infant can be an important determiner of the kinds of situations producable by the caregiver, whom the infant encounters. He also suggests

that "...the emergence of a particular emotion, along with correlative changes in other systems marks the beginning of a 'critical period' for certain types of experiences and for learning of certain types of responses that are important to development at that particular state of life." (p.169). Thus, temperament cannot be detached from the formation of the regularities of behaviour of personality. The variations of environment during such critical phases will no doubt be very important, but so will genetically determined variations of emotional lability, reactivity, extent and ontogenesis. In short, it is impossible to have a theory of personality or personality development that is at all detailed, unless personality characteristics are studied with reference to temperament - environment interactions.

Other Theories of Personality and Emotion

How does the assembly model, and its type of explanation fit with other theories that seek to integrate personality and emotion? Epstein's (1983) theory in which emotions are seen to be a consequence of the adequacy or inadequacy of a personal theory of reality has already been noted. Epstein's theory makes cognitions most important in defining behavioural regularities, and emotions develop as a consequence of the cognitive structure. Arnold (1960) sees emotions both as consequences of self-ideals, and impetuses towards acquisition of valid self-ideals. She posits that the early process of identification with parents sets the child's self-ideal, and this self-ideal is the ultimate value in a value heirarchy which is involved in the appraisal process contributing to emotions being felt. There is a considerable degree of

similarity between the theories of Epstein and Arnold in that for both there is a cognitive processing of the environment in terms of existing structures (world theory or value heirarchy) which occurs prior to the onset of emotion. In contrast to the microprocess assembly model, these theories see emotional reactions as results of personal constructs, not the determinant processes of personality manifestation.

Two theorists that have theories more congruent with the model advocated in this thesis are Plutchik and Izard. Plutchik (1980, 1962) suggests ways in which the ordering of traits is reflective of the ordering of emotions, but does not provide explanation of the parallel. The parallel is expanded somewhat by Kellerman (1980), but still is fairly unspecified and speculative. In contrast, Izard (1977, 1979) states in more detail the linkage between personality and affect. Izard argues that personality integration involves the development of effective interrelations and interactions between the processes of the set of primary emotions and particular types of processes employed by other systems. For example, interest, attention, and exploratory behaviour may be unconnected in the neonate, but via learning and adaptation, interest, attending and exploration will become part of a single personality complex. His formulation emphasises the importance of emotions in setting the conditions for the uptake and processing of information. This emphasis on explaining personality in terms of emotion related process characteristics is common to differential emotion theory and the microprocess assembly model.

Omnibus Personality Models are not Personality Models

As the Figure 2-1 indicates, the microprocess assembly model of personality is not a complete account of individual functioning, but it represents a deliberate submodel of a more extensive model. One virtue of considering a submodel in preference to a full model, is that certain subsections of behaviour can be cut out of consideration as relevant to the model. Explicitly, those sections of behaviour that represent acquired units available to any person who encounters the precursor learning environment should be excluded from consideration. One qualification to this statement is that if the acquired behaviour is correlative with an acquired and stable cognitive structure that influences the development of other personal behaviours then it should be regarded as part of the data base of personality. Thus, it is proposed here that personality be restricted to variations in behaviour between individuals that is not consequential on the previous learning environments of the individuals. The influence of learning should only be considered when it results in psychological structures that produce individual differences that require an explanation in terms of unique temperament-environment interactional origins. By following such a restriction it becomes easy to distinguish between a level of behaviour that is more cultural and does not require linking to individual types, from a level of behaviour that manifests differences of which the individual is the locus. In short, personality theory has gone astray when it is applied to between culture differences; its proper domain is within culture variation.

The suggestion above is not new, but it bears repeating because it is not often observed. Possibly this is because of the seductiveness of a high correlation between a particular construct and one kind of situational behaviour. On the need to separate the situation, Bem (1983) writes that "...if we hope to formulate a truly interactional model of persons in situations, then I believe that our person variables and our situation variables must be pure and explicitly distinct from one another. In particular, the person variables need to be formulated at a fairly genotypic level of personality functioning, at the level ... of temperament or general personality traits. And among these, I believe the most promising are those that refer to an individual's stylistic ways of processing information and interacting with the internal and external environment." (Bem 1983, p.218). The microprocess assembly model fulfils Bem's suggestions in two ways. Firstly it takes as its building blocks of explanation the processes operating when affect is triggered and so is at a genotypic level of personality functioning. Secondly, it explains differences in behaviour in terms of the characteristic processes which an individual will bring to bear on an environment and the consequential outcome of the analysis. Thus, the model will explain behaviour in a situation by relating what the person does cognitively in a particular context, to the cognitive tendencies activated by their microprocess assembly characteristics.

The solution to the situationist controversy (Michel, 1968) of the microprocess assembly model is to drop out of the sphere of personality, those behaviours purely situation-

ally predicted. While this may seem like defining away the problem it is in fact more than that. As pointed out by Mischel (1983a), the controversy arises because the discrepancy between the consistency in human behaviour that our intuitions suggest, contrast with the cross-situational inconsistency shown by empirical research. When the position is taken that personality should not be used to explain situationally determined behaviour, it is an admission that for some behaviour, the dynamics of individual cognitive and affective structures are not differentiating factors. Personality theory does not have to set itself the task of predicting all the behaviour all of the time. Rather than serving as an omnibus theory of behaviour, when relatively situationally determined behaviours are deleted, personality theory becomes a true theory of individuality.

Interestingly the microprocess assembly model's approach to situations is substantially in agreement with Mischel in that it operates with psychological variables such as competencies, encoding strategies etc in preference to semantic categories such as 'friendliness' or 'punctuality'. It thus employs some of the same kind of processes that are used by Mischel in his analysis of an individual within a specific situation. It diverges from the social learning approach of Mischel in that its focus is on the within individual influences on behaviour, whereas Mischel's primary focus is on within situation influences on behaviour. Both approaches have virtues and a convergent middle ground where limitation of the assumption set of one or other approach converts it to the other approach (e.g. restriction of the social learning theory approach to situationally

invariant attributes of the individual will make it substantially similar to the approach offered here). But the microprocess assembly model's meta-theoretical structure is specifically intended to keep its explanatory locus within the bounds of a concrete 'personality system'. As a concrete system approach, it claims to be a better theory of personality (not behaviour) than other more inclusive and omnibus theories.

The Level and Units of the Microprocess Assembly Model (M.P.A.)

The MPA model is preferred to the full model of Figure 2-1(a) because it is intended to be better suited than a full model to the explication of personality as defined here. In contrast with the emotion characteristics (E.C.) submodel (Fig. 2-1(b)), the MPA model is non motivational and seeks to explain the behaviour within its range of convenience, not by the why of the actor, but by the how of the way in which environmental input is transformed into psychologically active information. It is not denied that individual differences in motivational characteristics do occur and are well described by emotional setpoints as Heisse (1979) has shown. There are however, several advantages of the MPA model when used to consider personality, that favour it over the more ecologically and linguistically valid approach of the EC model. These are now considered.

1. The MPA model does not have to have situational transients defined in order to demonstrate its efficacy. The demonstration of the EC model requires the relating of situational transients, behavioural strategies and the

characteristic setpoint of the individual. Thus a necessary adjunct to the EC model is a theory about the way in which situations map onto transients, or a direct measure of transients. In contrast empirical research in the MPA model can proceed by the demonstration of the microprocess assemblies operating in new situations producing a set of biases in situation representation.

2. The MPA model is at a more fundamental level than the EC model, and thus some of the results in the latter can be subsumed by the former, but not vice versa. For example, it is possible that emotional experience emerges partially as an interactive result of various subprocesses in much the same way as Luria (1978) and Hebb (1968) have suggested for consciousness. Even if emotional experience is not wholly a consequence of the rearrangement of normally operating cognitive processes, the attempt to maintain emotional setpoints will to some extent be understandable in terms of maintaining certain levels in a configuration of cognitive processes.

3. The MPA model does not use self report measures to establish its data base, and thus its data should be more readily interpretable. The EC model will employ the kinds of self report that are not always reliable or valid measures of affect (e.g. Deinstbier, 1979; Kelley & Michela, 1980; Nisbett & Wilson 1977; Erickson and Simon, 1980).

4. It can be argued that microprocesses underlying emotion are the most appropriate level to look for psychophenes (Fuller 1979). Fuller distinguishes between ostensible psychophenes which have direct physical measures and inferred psychophenes which are akin to the personality theorist's trait. Henderson (1979) has argued for the use of laboratory

independent factors in the study of behavioural genetics, and he points out that "In essence, then, the investigator who, through a logical analysis, breaks down performance in a certain test situation into component sub-characters, determines the relationship between subcharacters and then analyses genetically these groups of subcharacters, is likely to be doing much the same thing as the investigator who derives a number of factors from an extensive series of behavioural measures and genetically analyses them." (p.265). Thus, given the intimate connection between personality and emotional organisation, in order to make the connection between personality and situational emotionality there are two approaches. One is working up from situational emotionality to higher order factors which are not situation specific. The other is to obtain the subcharacter (microprocess) structure of emotional responses, and to employ these to describe organism-environment relations. The MPA model takes the latter tack. The EC model chooses to remain at the level of ostensible psychophenes with the danger that cultural and situational factors are not separated out of the personality construct set. The aim of a concrete systems approach is best served by the MPA model.

Summary and Conclusion

In this chapter the aim was to consider one of the limitations of personality theory; its development in terms of an abstract system theory. It has noted that there is a call for a more evolutionarily relevant personality framework among current theorists, and it was suggested that sociobiology may provide essential concepts towards that end. The means of obtaining personality constructs of biological significance was discussed, and it was suggested that an essential part of personality research is demonstrating the biological or information processing processes that underlie personality traits. It was suggested that personality theory would benefit by uncovering the microprocesses that operate in person-situation encounters and that in accord with the realist philosophy of science, such microprocesses could be used to provide explanation for nonreplicable as well as replicable phenomena.

In this chapter, the outline of a metatheory/model which would be a useful research heuristic was put forward. The microprocess assembly model of personality proposes that any cross-situational behavioural consistencies that are components of personality research are because of individually unique assemblies of microprocesses common to all persons. People are different in terms of the characteristic way in which resource is allocated to microprocess outputs. A program to discover a plausible set of microprocesses was advocated, and it was suggested that although to date undefined, the microprocess set underlying emotional experience would be most useful for the purpose of developing

a theory of personality.

Noting that the MPA model is most akin to what personality theories term temperament, it was suggested that the temperament-personality distinction is artificial. Similarities and differences between the MPA model and other theories of personality and emotion are noted. It was suggested that the MPA model is a superior metatheory to other personality approaches as its range of convenience is not all embracing and thus it encourages a concrete systems approach to individual differences.

Finally, several advantages of going to a more minute level than raw emotion for a theory of personality were noted. The EC model was contrasted with the MPA to draw these advantages out.

This entire chapter has been an enquiry into the methodology of constructing a personality theory that does not stand alone, but is integratable with other levels of a theory of living systems. The enquiry was embarked upon because it is clear that personality theories, while they are often predictive of behaviour, do not usually connect with other fields of scientific research to the extent that they can be ranked in terms of being consistent with our overall knowledge of the human being. From the enquiry has come a research strategy that has been initiated in the studies reported in subsequent sections of this thesis. The action sequence advocated for the personality scientist, of the isolation of useful processes (for later explanation), their validation by biometric analysis, and relating of manifest personality to the operational configuration of such microprocesses, seems a bottom up strategy not yet attempted

by personality theorists. It promises to be more restraining on researchers in terms of linking personality and other levels of biological functioning, and thus may obtain this virtue lacked by current top-down theories of personality.

The subsequent sections of this thesis begin the work of the isolation of an emotion microprocess set. The research will be useful in the understanding of emotion and cognition. It is the position taken in this chapter that research like this will also be useful in the development of personality theory.

Chapter three: Perceptual defense : Experiments investigating the effects of arousal on perceptual processes.

The notion of perceptual defence has had a controversial history, since it was first demonstrated by McGinnes (1949). A thorough review of the studies that lend support to perceptual defence as a genuine phenomenon, is to be found in Dixon (1981). Early studies suffer from a lack of a theoretical framework. Hence for some researchers, the results were more experimental anomalies to be explained away than part of the corpus of the science of psychology (e.g. Eriksen, 1960). The introduction of an information processing paradigm to the field of psychology provided a framework that could accommodate perceptual defence studies in its data base. A thorough analysis of how perceptual defence can be accommodated within an information processing framework is provided by Erdelyi (1974). The basic conclusion that Erdelyi comes to is that perceptual defence can operate at different levels within an information processing sequence. The concept of monitoring links between stages shows it is possible for the output of a later stage to influence the processing of an earlier stage.

Accepting perceptual defence as a replicable phenomenon not antithetical to scientific psychology, demands that it be thoroughly investigated by emotion researchers. In particular, there is some evidence that there are individual differences in the extent to which defence is displayed (e.g. Dixon, 1966). The extent to which subject's emotional states give rise to these differences has not been examined.

Wagstaff (1974), in reviewing the literature on perceptual vigilance, suggests that whether defence or vigilance is displayed, may be a function of sex, stimulus emotionality, and certain personality characteristics such as subject repression. The last of these might well be related to subject emotionality, and raises the possibility of emotion-state influences on perceptual processes.

There is some evidence that an emotion system might influence perception. Zajonc (1980) argues that the locus of emotionality lies within the limbic system, and that this system was capable of maintenance of the organism in the environment prior to the evolution of the neocortex. Dixon (1971, 1981) suggests that "... the cortex can regulate its own level of activation by centrifugal control of the ascending reticular activating system." (1981, p.216). Dixon (1981) also suggests that emotional analysis might be important in determining such cortically controlled patterns of activation.

In terms of current neurophysiological understanding the regulation of perception by emotional factors is quite plausible. It is well established that reticular activity (among other brain mechanisms), may act to inhibit the initiation of impulses from peripheral sensory pathways (e.g. Ganong, 1977). Since limbic arousal (associated with emotion) has been suggested as mutually inhibitory with reticular arousal (Routtenberg 1968), there are known mechanisms which can account for an emotional influence on perception.

Experiment I

The present experiments were designed, firstly, to produce an unambiguous demonstration of perceptual defence, and secondly to examine the influence that arousal has on this defence. It seems plausible in light of the discussion above, that arousal being a component of emotion (Schacter & Singer, 1962), might influence the processing of information. If the level of perceptual defence can be shown to covary with arousal, this would be evidence of a linkage between the emotion system, and the perceptual system.

The first experiment was based upon an experiment of Marcel (1979), where he provided subjects with words, and primes in a lexical decision procedure. He found different prime consequences depending upon whether the prime was subliminal or conscious and whether it was energy or pattern masked. In the present experiment, there could be no semantic relationship between prime and target, since the targets were 4-digit numbers which had to be reported. It was however expected that there would be a disruptive influence of the primes (which consisted of emotional and taboo words), in much the same manner as subliminal stimuli have been shown to affect the subjective intensity of a spot of light presented to the eye that does not receive the subliminal stimulus (Dixon, 1958). If perceptual defence could be demonstrated using such a paradigm, it would add to the studies that have controlled for the obvious problems of response biases and word frequency, (as for example Dixon, 1958; Williams & Evans, 1980 employing a lexical decision procedure), and would provide evidence that perceptual defence is not localised to the processing of the defended

stimulus, but that it has ongoing effects on the entire processing system.

Method

Subjects: The subjects were 10 University of Canterbury students recruited from first year laboratory classes. The subjects received no payment for taking part in the experiment which took about 50 minutes to complete.

Stimulus Materials and Design

Ten emotional words were selected from a longer list which was put together on the basis of the degree of emotional connotation that they conveyed to the researcher. Of these words, two each were taken from the conceptual domains of sex, religion, bodily distress, excrement and threat. The Thorndike-Lorge word frequency (Thorndike, 1932) was found for each of these words, and they were matched by control words of the same length and word frequency count. Another comparison condition was produced by scrambling the letters of the emotional words.

The stimulus words for the emotional word condition were SEX, PENIS, SHIT, VOMIT, CHRIST, GOD, PAIN, BLOOD, KILL, HATE. The stimulus words for the neutral word condition were KIT, HUMID, HAZE, BLAND, CASINO, HAT, PAGE, VOICE, STEP, PACK. The words in the second list match the emotional words of the previous list in word frequency.

Stimuli were drawn with black felt tip pens on white card with the aid of a stencil. The visual angle subtended by a stimulus word was approximately 4 degrees. All stimuli were presented in a Scientific Prototype MFG Corp Model GB

3-field tachistoscope. Timing was shared between the tachistoscope timing unit, and a Lafayette eight bank program timer model 52021. The timing sequence is detailed in Figure (3-1).

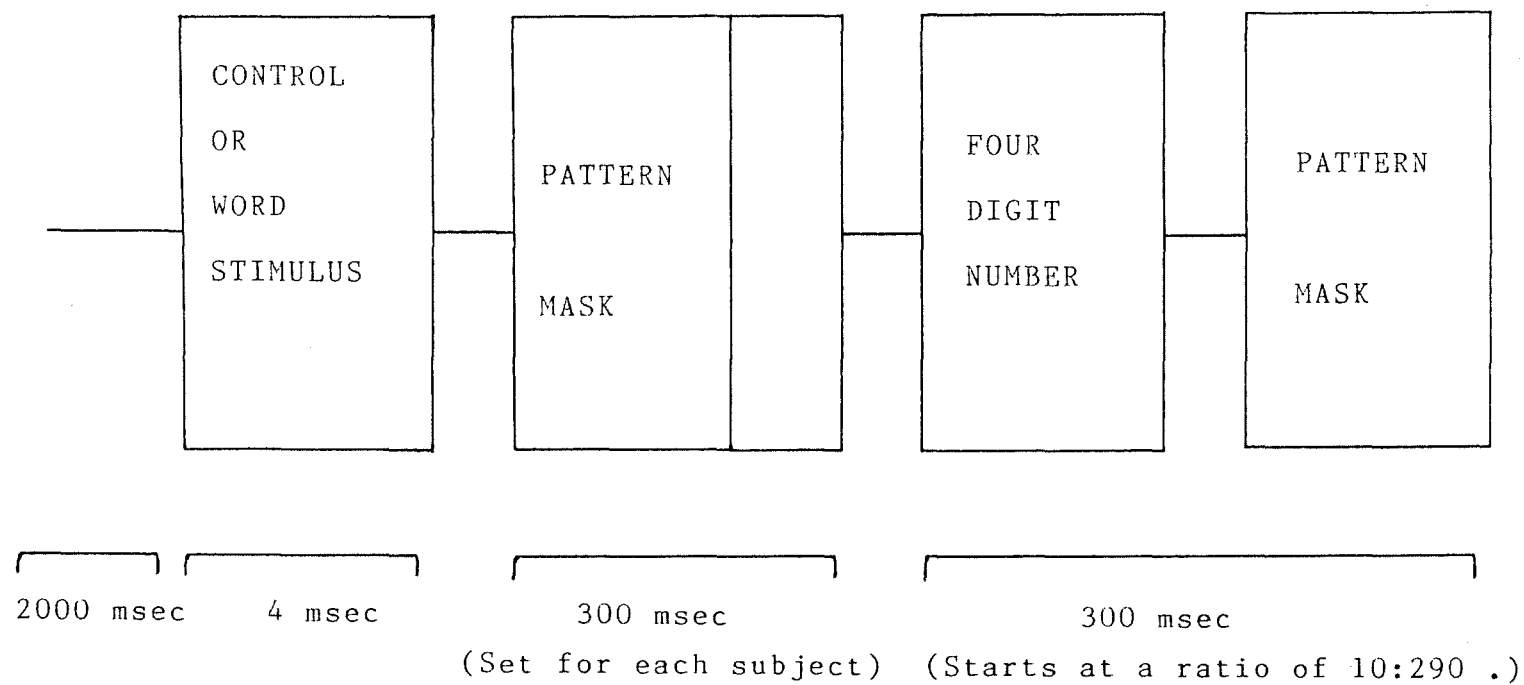
The order of presentation, was arranged so that half the subjects received a neutral word first, and half the subjects received an emotional word first. Thereafter, the presentation followed the sequence; scrambled control, and then either the emotional word stimulus or the neutral word stimulus (if the first stimulus had been neutral or emotional respectively). The five emotional content areas were presented in a different order for each subject, so that each emotional stimulus and its controls were found an equal number of times in each place in the presentation order. Thus the design was balanced so that valid comparisons could be made between the thresholds of the three kinds of stimuli, as well as for the stimuli from two semantic domains.

Procedure

The subjects, were initially briefed that the experiment was concerned with tachistoscopic recognition thresholds for numbers. They then had a series of twelve practice trials. The first two practice trials were to familiarise subjects with recognition tasks under conditions of tachistoscopic presentation. The next six trials were to establish an approximate word recognition threshold. The final four practice trials provided a preview of the digit report procedure of the present experiment.

The word recognition threshold was established by starting with a full 300 msec pattern mask (see Figure (3-1)),

FIGURE (3-1) TIMING SEQUENCE FOR EXPERIMENT I.



and progressively decreasing the duration of the mask until the word was correctly reported. The threshold was set by the fastest onset of the mask that allowed correct reporting of one of the practice words. Subliminality was obtained by setting the time for the mask onset to 15 msec less than threshold.

Once the duration of the subliminal words was established, subjects received four practice trials. These trials were precisely the same as the trials for the experiment proper (described below). At the end of practice, the experimenter indicated that the experiment proper was commencing.

The digit threshold for each trial was established by starting with a ratio of digit duration to mask duration of zero, and progressively incrementing the digit duration by 5 msec until the subject correctly reported the digits presented on three consecutive occasions. The digit threshold was taken as the digit duration that resulted in the first correct report of the three consecutive reports. The subjects were given no feedback as to whether they were correct or incorrect in part or in full, until they had completed three consecutive correct reports.

At the end of the experiment, subjects were asked whether they could report seeing a word during the experiment. After this, they were then told about the true purpose of the experiment, and allowed to discuss their results with the experimenter. Subjects were asked not to reveal the purpose of the experiment to future subjects.

Results

Medians were used for the analysis since an inspection

of the raw data revealed a pattern of positive skew which could have been a consequence of the reluctance of subjects to reformulate a near correct report about the digits. (Perhaps because of a strong influence of mental set). This reluctance to reformulate a partially correct hypothesis resulted in a disproportionate number of observations falling into the very high end of the distribution of digit thresholds, and this end should be regarded as contaminated.

A repeated measures analysis of variance was conducted on the median digit threshold, where the repeated factor was the kind of subliminal stimulus (emotional word, neutral word, non word). The mean thresholds for each condition and the significant contrasts are given in Table (3-2). The value of the overall F test was $F(2,8) = 3.69$, ($p < .08$), which approached significance. The only significant contrast was between emotional words, and nonwords ($t(1,7) = 3.287$, $p < .05$).

Discussion

The results obtained were consistent with those expected for perceptual defence. While the overall F ratio only approached significance, the comparison of the nonword controls and the emotional words was statistically significant. The condition of word frequency matched neutral words produced a digit threshold intermediate between that of emotional words and the scrambled letters. This intermediate result is suggestive that the 'defence' produced in this experiment could be demonstrated for any meaningful word stimuli. The emotional words may have produced a larger effect because of their higher semantic salience, but the same processes might have operated on both sets of words.

Two studies lend support to the possibility that it is

FIGURE (3-2).

DIGIT THRESHOLDS FOR SUBLIMINAL CONDITIONS

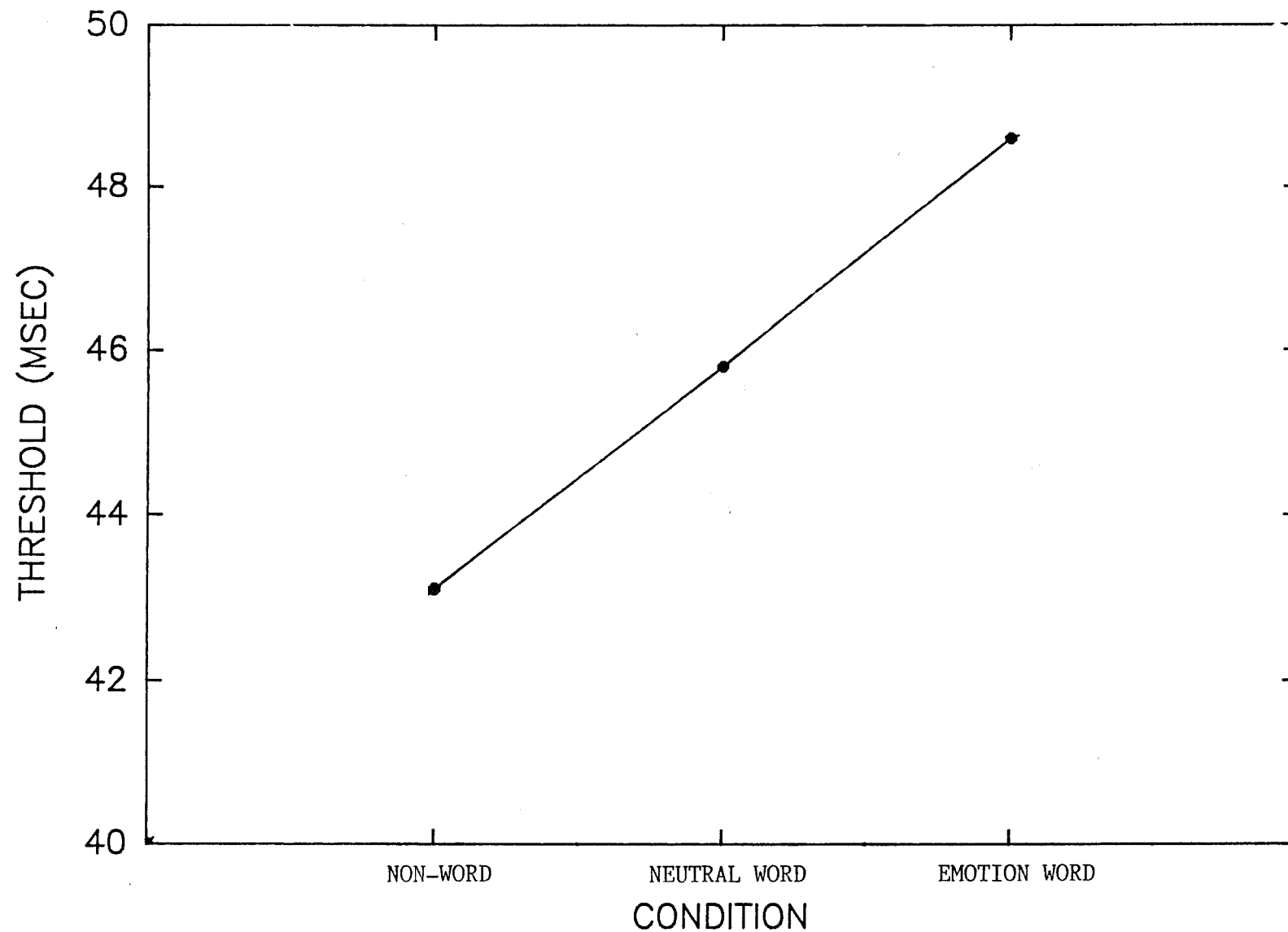


TABLE (3-1) MEAN DIGIT THRESHOLDS (MSEC) FOR EACH KIND OF SUBLIMINAL PRIME. (EXP I.)

EMOTION	NEUTRAL	NON
WORD	WORD	WORD
48.6	45.8	43.1

Conditions not joined by a line are significantly different ($p < .05$).

TABLE (3-2) MEAN THRESHOLD DIFFERENCES BETWEEN WORD STIMULI AND THEIR NONWORD CONTROLS. (EXPERIMENT II)

	<u>Word Emotionality</u>	
<u>Noise</u>		
<u>Control</u>	<u>Emotional</u>	<u>Neutral</u>
Noise	-3.125	-4.875b
Silent	+5.00a	-3.250b

Conditions with different letters differ significantly from each other ($p < .05$). A positive difference indicated perceptual defence.

TABLE (3-3) DIGIT THRESHOLDS (MSEC) IN EXPERIMENT II.

		<u>Noise Condition</u>	
<u>Emotionality</u>	<u>Type</u>	<u>Silent</u>	<u>Noise</u>
Emotional	Word	37.75	33.25
	Nonword	32.75	36.37
Non Emotional	Word	30.75	32.62
	Nonword	35.62	35.87

not just emotional material that disrupts the processing of other stimuli. Firstly, Philpott and Wilding (1979) showed that subliminal presentation to one eye at the same time as the other eye received a target stimulus, slowed the naming response to the target. They found that the increase in naming response time was apparent even when the target and the subliminal stimulus were unrelated. Secondly, an experiment by Humphreys (1981) showed that for a task involving categorical judgement, a preceding subliminal stimulus could prove facilitative or disruptive for the judgement. A preceding subliminal stimulus of the same category as the target stimulus improved target category report accuracy, while if the preceding subliminal stimulus was of the opposite category, target category report accuracy declined. (Both results are relative to a condition in which a blank field preceded the target stimulus).

The experiment clearly demonstrated that emotional words differ significantly from nonwords in their disruptive effects on the task of correctly reporting another stimulus. There are several possible explanations for this finding.

A first possibility is that the alerting (Posner, 1978, 1981) provided by the subliminal stimulus varies as an inverse function of its familiarity. This has been demonstrated for words presented as warning signals (Kraut, Smothergill & Mitchell, 1981). It could be argued that in the present experiment, because the scrambled letters were totally unfamiliar, the alerting produced by the nonwords was more than that produced by previously processed words. This greater alerting might result in superior performance at digit report for the nonwords. This explanation is not

favoured however since it is a naive version of stimulus novelty; it supposes that XXUN is more alerting than BOMB. In the absence of data to support this, the reverse view would seem more plausible.

A better explanation of the results is in terms of network dynamics. If the subliminal stimulus is responsible for a pattern of network activation, then the extent of interference with a stable pattern of activation for the digits will be proportional to the subliminal activation. Such an explanation is compatible with several recent models of network dynamics (e.g. Wicklegren, 1979; Grossberg, 1980; McClelland & Rummelhart, 1981).

The results of the first experiment can also be accounted for in terms of a modern account of perceptual defence. Dixon (1981) in distinguishing between six types of attention suggest that perceptual defence falls into the category of selective inattention (unconscious). He suggests that defence arises as a consequence of a dampening of the level of activation of the ascending reticular activating system. This dampening is supposed to be under cortical control.

Such an explanation can account for the differences between taboo and neutral or nonwords. However, if a real defence effect is also found for neutral words, then another explanation might be preferred. (Why should there be defence against non-emotional words?)

The next experiment looks at the viability of the defence explanation. In it the level of subject arousal is manipulated. Such a change in arousal might influence defence mechanisms. It was hoped that any changes towards defence or vigilance would provide clues to the cause of

perceptual defence.

Experiment II

Experiment I produced evidence that perceptual defence can be obtained using a procedure that does not require the reporting of the defended material. The second experiment looks at whether this defence is an epiphenomenon of normal information processing, or whether it has some adaptive significance.

The experiment looks at whether there are adaptive processes which ensure that the information in the environment related to current concerns (Klinger, 1982) gains access to awareness. It seems reasonable to postulate such processes, since many behavioural and decision programmes operate on the material which the individual is aware of. The idea of the experiment is that by changing the emotion related parameters of the subject's situation, the availability to awareness of material from various semantic domains will be altered. Experiment II seeks to introduce two distinct environments within which the experimental measurement of digit thresholds can occur.

The distinct environments are created by introducing white noise at places in the experiment. The white noise intervention was chosen because firstly it has been much employed previously in the study of the relationship between arousal and memory (see Eysenck, 1977 for a review of these studies). Secondly because white noise alters subject's arousal levels, it is affecting one of the accepted central components of emotion (e.g. Mandler, 1975; Schachter & Singer, 1962). If changing the emotional salience of the situation

can be demonstrated to change the extent of the perceptual defence exhibited by subjects, then a new and adaptive theory of the phenomena is called for.

The introduction of a manipulation which affects a component of emotion also allows assessment of whether the present task can furnish a measure of microprocesses that are involved in emotion. It will be remembered that the research strategy of Chapter two called for the isolation of such a microprocess set.

Method

Subjects: The subjects were 8 University of Canterbury students recruited from first year psychology classes. The subjects received no payment for taking part in the experiment which took about 50 minutes.

Stimulus Materials and Design

From the results of the previous experiment, four emotionally significant words that had produced a pattern of digit reaction times consistent with perceptual defence were chosen. The words were PENIS, VOMIT, CHRIST, KILL, and other stimuli were the neutral words of the same length and word frequency used as word controls in experiment I (HUMID, BLAND, CASINO, STEP), and also nonword controls obtained by scrambling the letters of the words. The words were displayed subliminally prior to the digit report and the setup, and display apparatus, were the same as that described for experiment I. During the course of the experiment, the emotional words, emotional controls, neutral words, neutral controls, were all presented twice; once with

a white noise background, and once without the white noise background. The white noise was produced by LAYFAYETTE MODEL 15012 WHITE NOISE GENERATOR and was presented simultaneously to each ear by STEREO HEADPHONE MODEL SM-220,

The factors of the experiment were TYPE (word, nonword), EMOTION (emotionally significant, neutral), NOISE (white noise, silence). The digits used in the experiment were rotated so that they were associated with each of the word stimuli - control stimuli pairs. As well, the word stimulus - control stimulus pairs were rotated to ensure that after all subjects had been run, each pair had appeared in every possible presentation position in the set of all pairs.

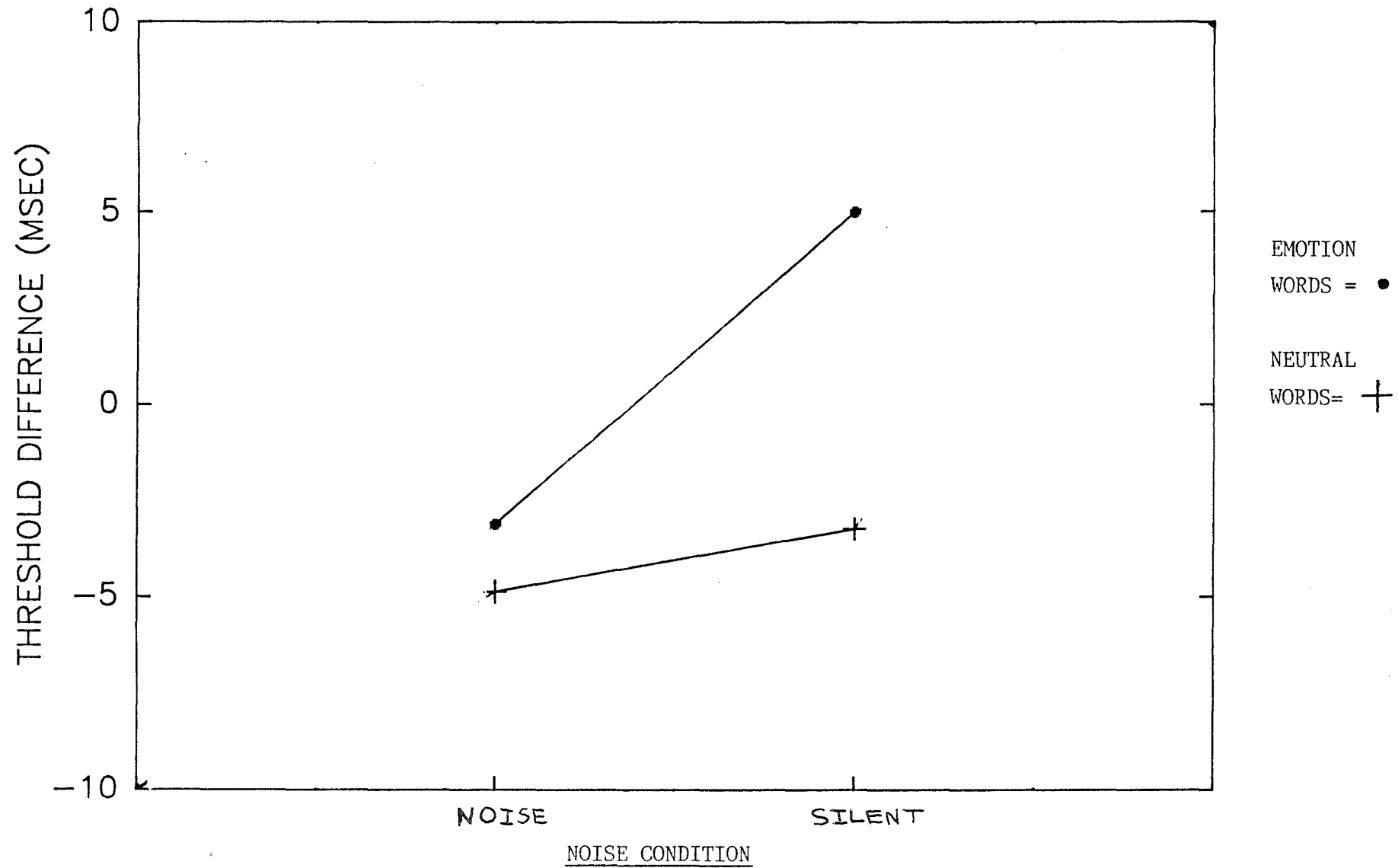
Procedure

The procedure was identical to that given for Experiment I, with the exception that at some point of the experiment white noise was introduced. The level of the white noise was set at the beginning of the experiment by increasing the volume of the white noise until the subject indicated that they found the level of noise uncomfortable. The setting for the noise was made at a level just below the level of discomfort. Half the subjects had white noise for their initial 16 and last 16 trials, while the rest of the subjects experienced the white noise in the middle 32 trials. Apart from this introduction of white noise, the procedure was completely identical to that of Experiment I.

Results

As in Experiment I, median threshold times were calculated for each subject in each condition. These eight measures

FIGURE (3-3). PERCEPTUAL DEFENSE PRODUCED BY WORDS AND NOISE



were then reduced to four measures by subtracting the time for the control stimuli from the time for their corresponding word stimuli. The reasons for choosing the differenced times, (and four cell ANOVA), for analysis rather than the actual times are; firstly that the controls are specific to their words because they contain the letters of the words; secondly, the fact that words and corresponding controls are measured at the same point of time during the experiment also makes them very specific to each other. If as is suggested the controls and words are specific within each subject, there will be a greater reduction in error variance than if a full ANOVA with eight cells is used for analysis. One other reason for using difference scores is that they provide a ready made index of perceptual defense. A positive difference will indicate defence, and a negative difference will indicate vigilance. (For completeness, the undifferenced means of all conditions are reported in Table (3-3).)

Table (3-2) details the mean threshold differences for each word and noise combination. An analysis of variance revealed that there was a significant effect for the EMOTION factor: $F(1,7) = 9.49$, $p = .02$, but that there was no significant effect for the NOISE factor; $F(1,7) = 2.06$ $p < .19$, or the NOISE X EMOTION interaction; $F(1,7) = 2.18$ $p < .18$. These results are complicated somewhat by simple t-tests on the significance of the defence/vigilance under each condition. For both conditions with neutral word stimuli, there appeared to be evidence for vigilance. Without noise; $t(7) = 2.12$, $p < .1$ and with noise; $t(7) = 3.375$, $p < .01$. Neither of the noise conditions with the emotional word stimuli produced defence/vigilance effects. T-tests also showed differences

in the amount of defence produced by the emotion words in silence, and the two neutral word conditions; $t(7) = 2.38$, $p < .05$ for the comparison with the noise condition; $t(7) = 2.39$, $p < .05$ for the comparison with the silent condition. No other comparisons were significant so it was only for emotional words with noise that a shift towards perceptual vigilance was evident.

Discussion

The second experiment failed to replicate the perceptual defence that was obtained in the first experiment. The procedure was exactly the same except that the second experiment introduced a noise manipulation in half the trials. Any explanation of the results must address what the consequence of the noise was on the information processing leading up to digit perception.

Noise has been used in a number of experiments to alter the arousal levels of the subjects (see Eysenck (1977, 1982), for the review of some of these experiments). In the present experiment, it was used in one half of the trials performed by a subject. It was assumed (perhaps naively), that the noise would have an influence only on those trials on which it occurred. In fact the significant vigilance shown to neutral words in both parts of the experiment, indicates that the noise must have had an ongoing effect. It seems to have had a similar but less powerful influence on the emotional words; moving the condition which should have shown defence to being nonsignificantly different from the nonwords; moving the condition where it was coincidental with words to bordering upon exhibiting significant vigilance.

Why has the noise, and the arousal caused by the noise had the effect that it has had? There is little in the studies of the influence of noise on memory that seems relevant to the present experiment. The most relevant studies seem to be on the influence of noise on attention selectivity. The general finding there is that noise results in an increase in attention selectivity, and a decrease in attention capacity (Eysenck, 1982). Consequently, it might be expected that with an increase in noise, less attention will be devoted to the distracting subliminal stimuli. However, this only explains the attenuation of the defence of the first experiment by the introduction of noise in the second. It does not explain the reversal to a pattern of 'vigilance' in the case of the neutral subliminal words in Experiment II.

The results of the second experiment seem best explained in terms of two factors which were mentioned in Experiment I. The factors are the alerting consequences of words as warning signals, and the disruptive influence of recently presented information on material being presently processed.

The latter of these two factors has already been discussed in Experiment I. It was suggested that the presence of a subliminal word stimulus produced sufficient network activation to interfere with the encoding of the target digits. The interference of an irrelevant stimulus presented simultaneously with a target has been reviewed by Eriksen and Schultz (1978). Recently Kahneman, Treisman and Burkell (1983) have provided evidence that there may be interference from distractors, even when the distractors are removed at the time of presentation of the target

stimulus. It also seems from research by Kahneman and Chajczyk (1983) and Flowers, Polansky and Kerl (1981), that words produce considerably more interference with the encoding of target stimuli than do nonword letter stimuli.

The other factor needed to explain the results of the current experiment is the alerting consequences of the subliminal words presented prior to the target digits. As explained by Posner (1978, 1981), the effect of alerting is to increase the general level of receptivity of the organism to information. Kraut, Smothergill and Farkas (1981) have shown that word stimuli as warning signals have alerting consequences that increase with stimulus novelty. Words not previously presented have greater alerting consequences than familiarised words. Thus, if the alerting and orienting consequences of the subliminal neutral words are assumed to be greater than those of the nonwords (in Experiment II), this could give rise to the 'vigilance'.

The two factors that have been mentioned above produced a different set of results when presentation occurred without noise (Experiment I), than with noise (Experiment II). This needs to be explained.

It is proposed that one effect of the noise is to reduce the influence of the subliminal word on the semantic network. The consequence of this would be to reduce the interference of the subliminal stimuli with the encoding of target digits, and thus increase the relative importance of the alerting consequences of the subliminal stimuli. Evidence for this effect of noise upon the semantic network is provided by Singer, Bronstein and Miles (1981). They showed that the effect of noise was to remove the priming advantage enjoyed

by related primes in a lexical decision task.

The noise may also mean that the alerting and orienting consequences of stimuli may become more pronounced. The reasoning behind this is that any reduction in attentional capacity with arousal (Eysenck, 1982), will mean that the phasic readiness associated with alerting and orienting, will become more valuable to the processing of information.

In Experiment I (without noise), it is suggested that difference in thresholds between emotional words, neutral words and nonwords reflects the interference factor. In Experiment II, the orienting and alerting consequences of the respective stimuli become more important. Although the difference between emotional words and neutral words reflected an interference effect, the difference in orienting and alerting between words and nonwords, ensured perceptual vigilance for neutral words compared with nonwords.

One criticism that might be levelled against the explanation above is that it seems at first glance to be experiment specific. It is not obvious that it can be applied to explain the results of other experiments on perceptual defence. This criticism has some validity, but the attractiveness of a single 'defence' explanation should not blind us to the obvious inability of 'perceptual defence' accounts to explain all the data.

Take for example two 'classic' examples of perceptual defence often cited by its exponents as unambiguous demonstrations of defence. Dixon (1958), had subjects control the intensity of light spots while subliminal word stimuli were projected into one eye. Dixon (1971) reports that the results support the hypothesis "...that 'emotional' stimuli,

at subliminal intensities to one eye, would occasion changes to threshold for the other eye." (p, 192). In fact, irrespective of the emotionality of the subliminal words, there was a sensitivity increase. In the case of the female subjects there was perceptual vigilance to both neutral and emotional words (although vigilance to neutral words was stronger). Such a result requires a fuller account than just 'defense'.

Another example is the demonstration of a decline in sensitivity in a signal detection experiment when subliminal emotional words are presented concurrently with the target stimulus (Hardy and Legge, 1968). While such a result is congruent with an explanation in terms of non specific defence, it is also possible that the subliminal stimulus produced switches in attention to the unattended channel, with consequent performance deficits. Unless such alternative explanations are examined, perceptual defense has received less than a satisfactory analysis.

The explanation of the present results receives support from recent experiments reported by Posner (1982). They note that when a subject's attention is drawn to a cued place in space, and then returned to fixation, processing at the cued position is inhibited with respect to other positions in the visual field. They conclude that for spatial attention there are the opponent effects of inhibition and covert orienting which determine sensitivity to events. In the explanation of the current chapter, we have preferred to label the facilitatory process alerting and orienting. It is suspected that in the present experiments modality orienting may have become more important with the introduction

of the white noise. The present explanation takes it that visual word stimuli are more likely to produce a readiness to uptake information from the visual modality, than will nonword stimuli.

Taking the explanation a step further: the processes causing perceptual defence may be analogous at the semantic level to those discussed above for spacial attention. An early emotional encoding by a separate emotional memory system (c.f. Posner, 1975, Strongman, 1982) may produce a tendency to orient towards the emotional stimulus. However, the experimental situation which is non threatening will demand a dampening of activation accumulating at the level of emotional features. Consequently it is supposed that the initial tendency to orient and alert is counteracted by later inhibitory processes which prevent an over reaction to the emotional word. The effect of a dampening of the activation associated with one level of analysis with the activity associated with other levels can be quite profound (e.g. McClelland & Rumelhart, 1981; Rumelhart & McClelland, 1981).

The explanation put forward here is not all that much different to that put forward by Dixon (1971, 1981). However, it is couched in the terminology of modern attention theory, and it is more compatible with the idea of perceptual vigilance. It predicts that certain experimental procedures that give rise to alerting and orienting could produce examples of perceptual vigilance.

More importantly, it predicts that under ^{ab}normal environmental conditions, the processes that give rise to perceptual defence will be facilitative in the processing of emotional material. Under stressful conditions, the

inhibition of processing at an emotional level will not occur. Under such conditions, there will be a tendency to orient and process emotional information in preference to non emotional information.

Some indication of this tendency is demonstrated in an experiment by Nielsen and Sarason (1981). They showed in a shadowing task, that there are more intrusions from the unattended channel of taboo words, than of neutral words. Interestingly, it was only for subjects who could report the intrusions that there was a decline in shadowing performance caused by the taboo words. Such an effect is not predicted by perceptual defence accounts, since it is generally supposed that defence is nonspecific and occurs to all current input.

The argument put forward here, is that so called perceptual defence might be a consequence of the way in which the emotional encoding given emotional words, produces effects on attention processes. Extrapolating from the present experiments, it is possible that at high levels of emotional arousal, the early emotional encoding might result in more benefits than costs in the processing of emotional material. At high arousal levels, there may be 'attention capture', alerting, and orienting caused by emotional stimuli. Thus it is plausible that the interaction between stimulus materials, the mechanisms of attention, and arousal levels, results in the tuning of information processing to the analysis of emotionally relevant material. Such a tuning would obviously be functional, and might have been selected for.

Conclusion

Perceptual defense can be shown in many ways. However, there are many examples in the contemporary research into attention where nontarget information produces performance deficits. We do not label this interference defense, and perhaps we should not label changes in perceptual thresholds on presentation of emotional words as such either.

The present experiments have shown how one 'defense' phenomena was affected by auditory noise. The joint effects of the alerting, and the interference caused by the presented words seems to provide a parsimonious explanation of the results of these experiments.

It would seem that a more thorough analysis of perceptual defense experiments is required. It is not sufficient just to show a processing cost associated with emotional stimuli. Experiments must be planned to examine which microprocesses are responsible for these processing costs (defense). In this way, an understanding of the way in which microprocesses are coordinated to ensure optimal information processing in stressful environments can be achieved.

Chapter Four: An investigation of the consequence of emotion for spreading activation in the semantic network.

Recent research by Bower, Gilligan and Monteiro, (1978, 1981b), has provided data that has implicated emotion in retrieval processes, and also encoding processes. Bower et.al. (1978), demonstrated that hypnotically induced emotional states resulted in affect-state-dependent learning, but only under conditions where subjects had to learn two lists under differing emotional states. Bower (1981) explained the results obtained in terms of an associative network with emotion nodes that are active during emotional episodes, and whose activation can spread to event nodes which are connected to the emotional node. This account predicts that under particular emotional states, the material congruent with the ongoing emotion, will receive more attention and processing than information incongruent with the ongoing emotion. The prediction was confirmed in a series of experiments by Bower et.al. (1981), in which it was demonstrated that emotional states influenced which material was learned in narratives, but seemed to have little effect on recall of what had been learnt when the mood was neutral. While these results are well explained in semantic network terms, to date there has been no more direct attempt to demonstrate the influence of emotion on the semantic network. The experiments of this chapter were formulated to provide a direct demonstration of the effect of emotional states on activation within the semantic network.

Activation within the semantic network, has generally been investigated using semantic priming methods. For

example, Meyer and Schvaneveldt (1971) found that the lexical decision time for "Nurse" is less when it is preceded by "Doctor" than if it is preceded by "Butter". Such methods have been used to investigate the time course of the spread of activation in lexical memory (e.g. Warren, 1977), the activation produced by sentences (e.g. Foss, 1982), the effects of syntactic context (e.g. Seidenberg, Tannenhaus, Leiman & Bienkowski, 1982), the semantic activation consequences of pictures (e.g. Carr, McCauley & Sperber, 1982), among other phenomena. Such priming studies have proved very useful to date in developing an understanding of the operating principles of the semantic network. However, priming methods might not be those of first choice for investigating the influence of emotion on the semantic network.

A problem with using priming methods, is that recent evidence has suggested that priming methods may produce patterns of inhibition as well as patterns of facilitation in lexical decision tasks. For example Becker (1980) found that for lists with highly predictable prime-target associations facilitation occurred, whereas for lists with little predictability between prime and target, inhibition occurred. Posner (1982) in discussing this inhibition, suggests that it might have arisen as a consequence of the subject's active prediction of the target stimulus. Because the predictions will usually be wrong, the costs of a mismatched expectancy when consciously attending will be obtained (Posner, 1978).

In the light of the Becker's results, it seems desirable to investigate the effect of emotion on the semantic

network by a method which will minimize conscious attention artifacts. In other words, since Bower's theory of emotional nodes is a theory of the automatic spread of activation, it behoves us to confine our investigation to that level and exclude conscious attentional processes from our experimentation as much as is possible. We want to employ a method which will minimize the impact of the experimental context; avoiding artifacts of the emotion induction procedures (and the kinds of hypotheses that will be generated in subjects by such procedures).

A task which promises to be less influenced by conscious attention strategies, and still is a measure of activation in the semantic network, is the Warren task, (Warren 1972, 1974). This task is a modified Stroop task, (Stroop 1938) where the interference with colour naming is obtained via the activation of semantic networks and response schemas by stimulus material other than colour words. It has been found that the immediately prior presentation of an associate to the coloured word to which subjects respond, results in a significant amount of interference with the colour naming response. This increase in colour naming time has been taken to be an indicator of the strength of association between the priming word, and the word to which a response is required. The Warren task has been used to investigate processes affecting stimulus encoding (Warren 1972, 1974), lexical ambiguity and sentence processing (Conrad 1974), and developmental changes in the encoding of simple sentences (Kareev 1980). Since these tasks involve the naming of colours and the word that the colour forms is irrelevant to a subject's response, this kind of task should sample

the effects of automatic pathway activation more than that of conscious attention activation. Evidence supporting this assumption can be found in a study by Logan (1980), where a particular kind of paradigm closely analogous to the Stroop paradigm was demonstrated to have automatic and non-automatic components which would be made larger or smaller dependent on stimulus predictability (that is response relevance).

The following series of experiments involved emotion induction procedures followed by experimental periods during which subjects saw a range of stimulus words, and had to name the colour of a target word. Experiment I replicated the general experimental procedure of Warren (1972), while experiments II and III used the same Stroop type task with multiple words appearing, in an attempt to investigate some of the attentional properties of emotion.

Experiment I

The rationale behind the first experiment was that if subject emotionality produces a higher level of activation of emotion relevant conceptual nodes in the semantic network, this should result in a larger amount of interference in colour words semantically related or associatively related to the emotion, than to words which are unrelated to the emotion. Specifically, any such effects should show up most strongly on target colour words which are closely related to the emotion of interest, and should be absent from colour words which have no emotional content.

Method

Subjects: Subjects were 24 undergraduate students at the University of Canterbury. The subjects were recruited from laboratory classes on the basis that they were prepared to experience emotions of Fear and Joy, and they understood that the procedure would require some active role-play/fantasy on their parts. Subjects were paid a rate of \$5 per hour for the series of experiments which generally took about 2 hours.

Stimulus Materials and Design

Stimulus material was obtained with the following considerations in mind:

- 1) That there should if possible be a set of control words with no emotional connotations.
- 2) That subject strategies be minimized as much as possible by the almost complete crossing of list materials thereby making distractor-target pairings unpredictable. (If, emotion words preceded the emotional colour words in general, and neutral words preceded the neutral colour words in general, then it is likely that the subjects would engage in some predictive strategies. Since the hypothesised influence of emotion within semantic networks is taken to be found in the consequent patterns of spreading activation occurring automatically, the experiment was designed to minimize confounding influences).
- 3) That all materials should be matched as closely as possible in terms of word frequency, concreteness, and associative strengths.

The stimuli were obtained with a view to finding an equivalent in (emotional terms) to the categories of Battig and Montague (1969). To this end, the norms of Word association provided by Palermo and Jenkins (1964), were consulted in an attempt to obtain "category headers" from the terms that had been normed. As far as possible, it was hoped to obtain terms which corresponded to the semantic domains of four of the fundamental emotions posited by Izard (1977); Enjoyment-Joy, Anger-Rage, Fear-Terror, Distress-Anguish. The word association norms provided associations for the words joy, anger, afraid, and trouble and cry; the first three seemed to correspond reasonably closely to the fundamental emotions being investigated, while the judicious use of the last two word norms was hoped to provide material that corresponds to the Distress-Anguish emotion. A final selection of emotional terms for each category was made weighing each of the following factors up

- 1) The word frequency count. (Thorndike 1932)
- 2) The frequency that a word was found to be an associate of another emotional category. (As much as possible it was desired to have words with a strong association with just one category).
- 3) The paucity of abstract emotionally same toned words meant that included within each category were not just state descriptive terms but also terms which were likely to be the object of emotion. For example, Joy included Friend as an associate.

The final words used are included in Appendix 1 with their word frequency counts. Also in Appendix 1, are examples of the stimuli for a 32 trial block including the words for each trial, with a classification of each prime-target pair in terms of the emotionality, category, and validity of pair members.

Stimulus Conditions (within subjects design).

Primes were of four possible types.

- 1) A row of four X's. (X condition). e.g. XXXX-Joy
- 2) Unrelated to the target stimulus in either category or emotionality. (N condition) e.g. JOY-APPLE or APPLE-MAD
- 3) From a different category to the target stimulus, but with the same level of emotional relevance. (SE condition) e.g. JOY-MAD or HOUR-APPLE
- 4) From the same category as the target stimulus (which means the same level of emotional relevance as well). (V condition) e.g. ANGRY-MAD or APPLE-PLUM

The total 128 stimuli for each subject, contained four presentations of each validity condition for each target category. Table 4-1b illustrates this crossing of validity conditions with target category. Table 4-1a expresses the crossings of prime types and target categories that were used in the experiment.

These tables illustrate that each subject had sixteen trials in which the emotional target words had primes from the same category, and sixteen trials in which the neutral target words had primes from their same category. There were also sixteen trials in which the prime and target

words had emotionality in common, and sixteen trials with prime and target having neutrality in common. Both emotional and neutral targets had sixteen trials with crosses as primes, and sixteen trials where they served as primes for each other.

The stimuli were presented in 32 trial blocks. Each trial block contained one stimulus from each of the four validity conditions for every one of the eight target categories. The prime stimuli never matched the target stimuli since the prime stimuli were taken from a second set of word stimuli. Half the subjects received one set of target stimuli, and half the subjects received the other set of target stimuli.

In terms of the stimulus factors that could be analysed in this experiment, the following stimulus factors were present

- 1) VALIDITY (X, N, SE, V).
- 2) EMOTION (E = Emotional words, N = Neutral words).
- 3) CATEGORY TARGET (E1, E2, E3, E4, N1, N2, N3, N4)
Categories 1 to 4 by EMOTION
- 4) CATEGORY PRIME (E1, E2, E3, E4, N1, N2, N3, N4)
Categories 1 to 4 by EMOTION
- 5) ABSTRACTNESS (A= Abstract words, C = Concrete words).

There was not a perfect crossing of each of these factors, so the experiment cannot be analysed as a full factorial design. As well, the number of trials performed by each subject made it necessary to restrict analysis to no more than two factors at once. Consequently in the analysis of the stimulus conditions the possibility exists that some complex interactions may have been missed.

Between Subjects Design

The emotion node model of Bower required that subjects be in different emotional states in order to be tested.. The affect induction procedure described elsewhere was employed in order to obtain a range of emotional states in the subjects. Because affect induction is not always effective, and because subjects bring a range of emotional states into an experiment it was decided to use a correlational analysis rather than an ANOVA to test the predictions of Bower's semantic network theory. The correlational analysis is justified by the fact that it can provide tests of the experimental hypotheses in the absence of a strong induction effect. As is pointed out in Cronbach and Snow (1977), the use of regression is always preferable to the use of median split methods to test the influence of an aptitude on a dependent measure. (In the two group case, the ANOVA is equivalent to a simple regression with the predictor variable having only two values).

The assumption is that if the results of the test of the emotion induction do not indicate the efficacy of the induction, at the very least they indicate a wide range of emotion within groups (contributing to the error variance). The effect of this emotion on the naming of the colour of an emotional coloured-word is ascertained from the significance of the correlation between the emotion and the difference in reaction time between the emotional word condition and its corresponding control condition.

The correlational analysis uses difference times, in preference to separate regressions because the use of such

times prevents the correlation reflecting intersubject differences in reaction time. Besides, as pointed out in Cook and Campbell (1979), difference scores result in a lowering of error variance if the separate scores are highly correlated (as is the case for the separate reaction times in this experiment). The use of differences between reaction times is considered in more depth in Chapter five.

By subtracting the reaction time of a neutral category, from that of an emotional category one is left with the processing time associated with the emotional nature of the stimuli. Specifically -

$$\text{RT control} = G + e.$$

$$\text{RT emotional word} = G + E + e.$$

Subtracting we obtain

$$\text{Reaction time difference} = E + e$$

Accordingly, because it conveys the meaning of the measure, throughout the rest of this chapter we refer to the reaction time difference calculated above as emotion time.

In practice, the differences obtained are proportional to the mean reaction times for each subject. Working with raw reaction times would have meant that reaction time differences were not as significant for subjects with low mean reaction times as for subjects with high mean reaction times. Accordingly throughout the correlations the emotion time is calculated by -

$$\begin{aligned} \text{Emotion time} &= \text{Log (RT emotional word/RT control)} \\ &= \text{Log (RT emotional word)} - \text{Log (RT control)} \end{aligned}$$

Figure 4-1 contains a set of example stimuli for the anger target category. All validity conditions have been

FIGURE (4-1) EXAMPLE PRIME AND TARGET STIMULI FOR EXPERIMENTS I, II AND III.

	Prime	Target	VALIDITY
	Stimulus	Stimulus	CONDITION
Expt 1	PEACH	HATE C1	Not Valid
	XXXX	HATE C1	X's
	JOY	HATE C1	Same Emotion
	ANGER	HATE C1	Valid
Expt 2		PEACH C1	
	XXXX	HATE C1	Not Valid
		PEACH C3	
	XXXX	XXXX C2	
		HATE C1	X's
	XXXX	XXXX C3	
		JOY C2	
	XXXX	HATE C1	Same Emotion
		JOY C3	
	XXXX	ANGER C2	
		HATE C1	Valid
		ANGER C3	
Expt 3		ANGER C1	
	XXXX	XXXX C1	Same Colour
		PEACH C2	
	XXXX	ANGER C2	
		XXXX C1	Different Colour
		PEACH C1	

C1 = Colour 1, C2 = Colour 2, C3 = Colour 3.

TABLE (4-1a) PRIME AND TARGET CATEGORY PAIRINGS FOR EXPERIMENT 1.

<u>Validity</u>	<u>Distractor</u>	<u>Target Category</u>				<u>Distractor</u>	<u>Target Category</u>			
<u>Condition</u>	<u>Stimulus</u>	<u>E1</u>	<u>E2</u>	<u>E3</u>	<u>E4</u>	<u>Stimulus</u>	<u>N1</u>	<u>N2</u>	<u>N3</u>	<u>N4</u>
X	X	4	4	4	4	X	4	4	4	4
N	N1		2	1	1	E1		2	1	1
	N2	2		1	1	E2	2		1	1
	N3	1	1		2	E3	1	1		2
	N4	1	1	2		E4	1	1	2	
SE	E1		2	1	1	N1		2	1	1
	E2	2		1	1	N2	2		1	1
	E3	1	1		2	N3	1	1		2
	E4	1	1	2		N4	1	1	2	
V	E1	4				N1	4			
	E2		4			N2		4		
	E3			4		N3			4	
	E4				4	N4				4

TABLE (4-1b) STIMULUS CONDITIONS FOR EXPERIMENT 1.

		<u>Target Category</u>							
<u>Validity</u>									
<u>Condition</u>		E1	E2	E3	E4	N1	N2	N3	N4
<u>XX's</u>		4	4	4	4	4	4	4	4
<u>VALID</u>		4	4	4	4	4	4	4	4
<u>SAME EMOTION</u>		4	4	4	4	4	4	4	4
<u>NOT VALID</u>		4	4	4	4	4	4	4	4

Category Codes: E1 = Fear, E2 = Anger, E3 = Happiness,
 E4 = Distress, N1 = Weather, N2 = Fruit, N3 = Time,
 N4 = Literature.

exemplified. Stimulus examples for experiments II and III are also included.

Several specific tests of the locus of emotional activation in the semantic network should be possible with the categories of stimulus material given in Table (4-1).

I) The emotional activation hypothesis without any refinements, predicts that the correlation between the emotion-time of a particular emotional category with the level of a particular induced affect, will be highest when the emotional category and the affect correspond. Such a prediction should hold across all types of prime-stimulus conditions.

II) If the effect above is present, then it should arise most strongly for nonpredictive primes if the emotional influence is predominantly on patterns of automatic activation. If on the other hand the effects mentioned above arise because of an amplification of material relevant to the induced affect by conscious attention strategies, then the correlation between emotion-time and affective state should be higher in trials with predictive primes.

III) If the activity of a particular node in memory is related to working memory processes (e.g. Wicklegren 1979), and if as has been suggested by Bower (1981), particular active emotion nodes inhibit nodes of antagonistic emotions, then there should be a negative correlation between affective states and emotion-times in trials where target words represent emotions that are antagonistic to the emotional states induced in the subjects. For example, when the priming stimulus is XXXX, then a target stimulus of ANGER, should show less interference in colour naming given that joy has

been induced in the subjects, than a target stimulus of APPLE. The reason for this, is that the anger concept node is being somewhat inhibited by the induced emotion, and therefore has a lower resting activity and is less likely to provide significant interference in the response selection/decision processes involved in colour naming.

The colour words were presented in bold upper case letters coloured either orange, green or blue and subtended a visual angle of between 3 and 4 degrees. The words were displayed on a Karga (model KS14P) colour monitor, and the experiment was controlled by an Apple II + microcomputer. The program to control the experiment was written by the author, and is listed in Appendix 3. Subject responses were timed via a voice activated relay consisting of a MTL F-96 microphone and a Realistic CTR-40 tape recorder which fed into the computer cassette input. The time taken for the subject to respond was calculated from an assembly language program written by the author, and modified from a program described by Price (1979). The rapid presentation of the word stimuli involved writing the word on a non displayed screen, and then displaying the screen using the Apple software switches for graphics in a manner detailed by Cavanagh and Anstis (1980). The timing accuracy was to the nearest millisecond.

Materials for Emotion Induction

Subjects in the emotion induction conditions chose six TAT pictures, to which they would tell stories having an emotional content congruent with the affect being induced. The Thematic Apperception Test (Murray, 1943) stimuli were

used because responses to these stimuli are usually characterised by a range of emotions. Consequently it was hoped that emotions could be induced by having subjects tell stories to these stimuli. Story telling has been used successfully as a means of affect induction (Masters, Barden & Ford, 1979).

Procedure

Subjects were assigned randomly into one of three experimental groups on their arrival. They were told that the purpose of the experiment was to study the influence of emotion on information processing, and that emotion induction techniques would be used in order to "bias their emotions". At this point, the subjects were asked to go through the full set of TAT stimuli, and pick out cards they could tell happy/fearful/non emotional stories to. Which kind of story depended on the mood induction condition assigned to the subjects. The subjects were then given 20 practice colour naming trials in which they had to name the colour of a set of neutral words not used in the experiment.

The experiment proper now commenced. Subjects were asked to tell a story to the first of the TAT cards that they had chosen. The instructions read

"This is a test of how well you can become emotionally involved through the use of your imagination. For the five stimuli that you have chosen, at various times in the experiment you will be asked to tell emotional stories that should take about two to four minutes. I will show you the pictures and you should make up as '____' a story

as you can for each. Tell what has led up to the event shown in the picture, describe what is happening at the moment, (and try to become the person that this is happening to and feel the same -----ness that they are experiencing). Describe (what you must be feeling and thinking) as vividly as you can, and if you want to, describe the outcome. Speak your thoughts as they come to mind. Do you understand? (To do well, you should forget that you are (Person's Name) and really become involved in the experiences of the person in the picture.)"

(The dashes contain the word appropriate to the stimulus condition that the subject was in; either happy, fearful, or neutral. The bracketed portions were deleted in the instructions for the neutral condition.)

Every second block of trials involved the telling of a story (experiments were run one after another). In between story telling trial blocks were blocks where subjects had to recall (to themselves) emotional memories. It was hoped, that using two emotion induction techniques, would prove to be more powerful than one. The instructions for emotional memory recall for the two emotion conditions were:

"Recall an event in your life that provoked feelings of '----'. Can you think of such an event?" (Wait for subject to affirm).

"Now for the next two or three minutes I would ask you to recall, visualise or imagine (to yourself), all the details of this event as vividly as possible. In particular try to recapture what you were thinking and feeling when this event occurred. It may help to shut your eyes. I will tell you when to stop."

(The dash was either happiness or fear depending on the condition.)

The instructions for the neutral group at this point in the experiment were:

"For the next two or three minutes, take a break, turn off your mind and relax. You may shut your eyes if you like".

The sequence of events that occurred in a typical trial are now described. There was a 1 second appearance of either four Xs, or a priming word 2 seconds after the subject pressed a key to commence a trial. This stimulus, the subject was required to recall after naming the colour of a word stimulus which appeared on the screen 4 seconds after the initial presentation. Subjects had been told to name the colour of the coloured word as rapidly as they could without making a mistake. At the end of this sequence of events (priming stimulus, target stimulus, colour naming, recall of the priming stimulus) the subjects could commence another trial by pressing a key. Any mistakes in colour naming were pointed out to the subject prior to the commencement of a new trial, while errors in recall were not corrected, but were generally obvious to subjects. At three points during the experiments, subjects completed a modified version of the Differential Emotion Scale (DES) (Izard 1972). The first form was completed at the end of experiment I and prior to experiment II; the second form was completed at the finish of the second experiment; the final form was completed at the end of the third experiment. The first two scales measured emotional states, the last scale measured emotional traits (see Appendix 2).

Results

Correlations between emotion-time for word stimuli from each emotional category with the ratings on the emotion scales which corresponded to each category were computed. The correlations which should have been largest were those between corresponding emotion-times and emotion scales. Consequently these correlations are examined first, and are reported in Table (4-3). There is only one significant correlation out of the 15 reported, and this lack of relationship between emotion-times and emotion rating scale scores was also evidenced when the two correlated measures came from different categories. (Note also that the correlations were still without appreciable numbers of significant correlations when separate correlations between emotion-times and emotion rating scores were performed for each validity condition between prime and cue stimuli.)

The effectiveness of the emotion induction procedure was evaluated by a between groups ANOVA on each of the two emotion rating scales corresponding to the induction emotions. The ANOVA summaries are provided in Tables (4-4a) and (4-4b). The results indicate that there was no significant effect for induction group although the Group factor bordered on significance for the joy measures. Table (4-5) contains the mean scores on each emotion rating scale for the four emotions represented within the experimental stimuli.

Table (4-6) contains the mean reaction time for each of the thirty two conditions obtained by crossing Validity with Category . The data for this table was screened by employing cutoffs of 500 msec (low) and 2000 msec (high).

TABLE (4-3) CORRELATIONS BETWEEN EMOTION TIMES (MSEC) AND
CORRESPONDING RATING SCALES SCORES (EXP. I).

Scales administered after -	<u>Emotion-Times</u>			
	Fear	Anger	Joy	Distress
Exp I	.36*	-.10	-.06	.01
Exp II	-.02	-.14	-.11	-.02
Exp III	.31	-.22	.06	.09

* $p < .05$ (One-tailed test)

TABLE (4-4a) ANALYSIS OF VARIANCE TABLE FOR RATINGS OF FEAR

<u>Effect</u>	SS	df	MS	F
Time	65.3	1	65.33	10.23*
Group	45.5	2	22.75	1.63
Time X Group	7.166	2	3.58	.56
Error between	292.75	21	13.94	
Error within	134.5	21	6.38	

TABLE (4-4b) ANALYSIS OF VARIANCE TABLE FOR RATINGS OF JOY

<u>Effect</u>	SS	df	MS	F
Time	58.52	1	58.52	13.09*
Group	133.04	2	66.51	2.91
Time X Group	9.04	2	4.52	1.01
Error between	479.42	21	22.82	
Error within	93.92	21	4.47	

TABLE (4-5) MEANS LEVELS OF EXPERIMENTAL GROUPS ON
EMOTIONAL RATING SCALES

INDUCTION GROUP	EXP. I SCALES				EXP. II SCALES			
	Fe	An	Jo	Di	Fe	An	Jo	Di
Fear	5.0	2.0	7.3	2.6	2.0	1.9	4.6	2.4
Joy	2.9	.6	10	.9	.1	0	9	1.3
Control	4.2	.6	7.5	3.4	3.0	1.0	4.5	5.8

TABLE (4-6) MEAN REACTION TIMES (MSEC) FOR MAIN STIMULUS
CONDITIONS EXP. I.

<u>Emotion</u>	<u>Category</u>	<u>Validity</u>	<u>X</u>	<u>S</u>
Emotional	Fear	XXXX	842.7	256.2
		VAL	867.8	204.7
		SE	917.7	261.0
		N	884.6	211.1
	Anger	XXXX	878.3	218.8
		VAL	867.0	237.7
		SE	871.8	199.9
		N	880.2	227.4
	Joy	XXXX	815.3	187.9
		VAL	909.9	279.4
		SE	857.1	221.5
		N	909.5	282.2
	Distress	XXXX	844.5	279.3
		VAL	837.2	219.5
		SE	843.0	220.8
		N	867.5	246.2

Table 4-6 continued on next page

Table 4-6 Continued

<u>Emotion</u>	<u>Category</u>	<u>Validity</u>	<u>X</u>	<u>S</u>
Neutral	Weather	XXXX	844.0	201.3
		VAL	834.8	219.5
		SE	841.1	180.8
		N	853.6	214.5
	Fruit	XXXX	859.7	211.3
		VAL	850.9	198.6
		SE	881.2	201.2
		N	900.1	261.8
	Time	XXXX	841.4	199.6
		VAL	877.1	220.4
		SE	839.0	214.0
		N	861.3	206.6
	Writing	XXXX	837.7	230.3
		VAL	876.7	198.6
		SE	865.3	244.5
		N	854.0	211.7

For the statistical analysis (with fewer conditions) there was sufficient data per subject per condition to use 25% trimmed means to reduce outlier contamination. (Barnett & Lewis, 1978). Thus, there might be small discrepancies between means calculated from this table and the means reported elsewhere.

The analysis was done using the SPSS MANOVA program (Hull & Nie, 1981) and a multivariate approach to the repeated measures design. Separate ANOVAs were performed for the following stimulus factor pairings (crossed with the between subject factors of Induction group and List group): (Emotion, Validity), (Emotion, Category), (Emotion, Abstractness), (Prime Emotion, Prime Category). All of these ANOVAs with two within-subject factors and two grouping factors had significant or near significant effects. The results are reported in Table (4-7), with the Induction and List group factors absent, as they showed no statistically significant main effects. Also omitted from the tables, are the nonsignificant interactions; for the Induction group and List group factors, with the stimulus factors (for the purpose of reporting, the significance levels are taken at $P < .1$, although more rigorous ($p < .05$) significance levels are taken for rejecting the null hypothesis). The degrees of freedom for the approximate F tests ^{of Wilkes Lambda} have been omitted, but were calculated from Rao's formula (Rao, 1973), by the SPSS MANOVA program (Hull & Nie, 1981).

The means which gave rise to the significant Validity effect are listed in Table (4-8), and graphed in Figure (4-2). The lower value of the cross condition was expected, but the large value when the cue and target differed in emotional

FIGURE (4-2). NAMING LATENCIES FOR VALIDITY CONDITIONS (EXP1)

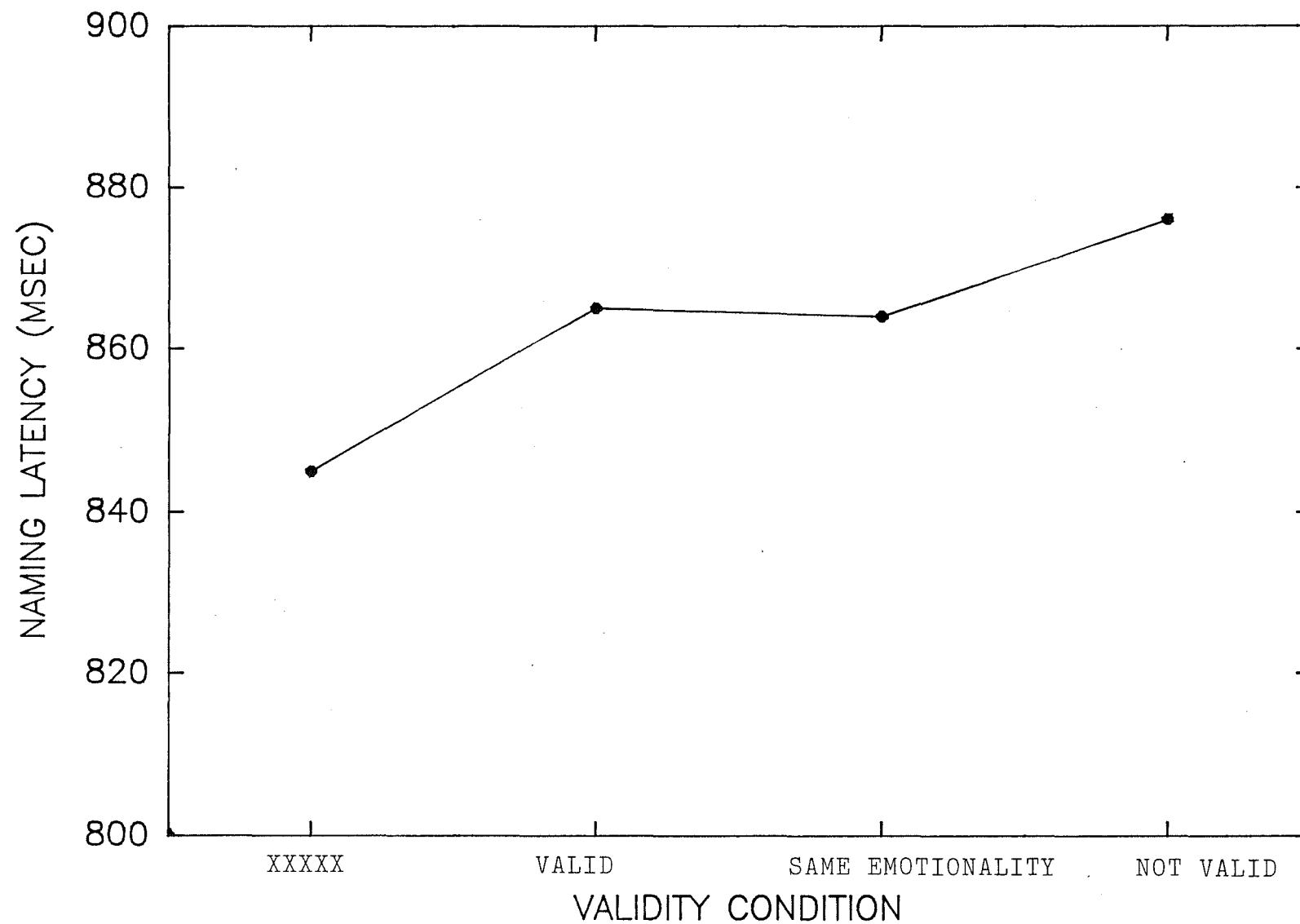


TABLE (4-7) SIGNIFICANT AND NEAR SIGNIFICANT EFFECTS OF WORD STIMULI (EXPERIMENT I)

(Within Subject Factors: Emotion, Validity)

<u>EFFECT</u>	<u>F Ratio</u>	<u>P</u>
List X Emotion	3.20	.091
Validity	4.46	.04
Induction X Emotion X Validity	2.12	.08

(Within Subject Factors: Emotion, Category)

<u>EFFECT</u>	<u>F Ratio</u>	<u>P</u>
Emotion X Category	2.5	.07

(Within Subject Factors: Emotion, Abstractness)

<u>EFFECT</u>	<u>F Ratio</u>	<u>P</u>
Emotion X Abstractness	4.62	.05

(Within Subject Factors: Prime Emotion, Prime Category)

<u>EFFECT</u>	<u>F Ratio</u>	<u>P</u>
Prime Em X Prime Cat	8.1	.002

TABLE (4-8) COLOUR NAMING LATENCY (MSEC) AND CUE-TARGET VALIDITY CONDITION

XXXX	VALID	SEM	DIFF
845.4	865.2	864.2	876.3

TABLE (4-9) COLOUR NAMING LATENCY (MSEC) AND STIMULUS CATEGORY

Fear	Anger	Joy	Distress	Weather	Fruit	Time	Literature
881	868	875	861	866	888	863	870

TABLE (4-10) COLOUR NAMING LATENCY (MSEC) AND PRIME CATEGORY

Fear	Anger	Joy	Distress	Weather	Fruit	Time	Literature
868	878	910	863	863	888	877	890

tone, was unexpected. The mean reaction time for each word category is in Table (4-9). The most significant Emotion x Abstractness effect is because words from the category of fruit had considerably longer times than those from other categories. The interaction Emotion x Abstractness arises because the mean reaction time for emotional more abstract words ($M = 880$) and non-emotional concrete words ($M = 875$) was considerably more than for emotional and concrete words ($M = 861$) or for neutral abstract words ($M = 867$). The Emotion x Prime Category arises because of the difference between the levels of individual mean reaction times for different prime category conditions, and it is not predicted by prime emotionality. The mean reaction times are set out in Table (4-10), and they indicate a large increase in reaction time when words from the category "joy" were the cuing to-be-remembered words.

Discussion

A) Differences between Subjects

Experiment I sought to test Bower's hypothesis that there are emotion nodes which interact with the semantic network and that these have consequences for the activation pattern throughout the network. The experiment failed to give any support to the notion of emotion nodes. The one significant correlation of Table (4-3) was almost certainly the consequence of Type I error for if it reflected a real correlation between emotion time for fear category stimuli and fear state levels, it would be expected that a parallel correlation would be evidenced in a similar condition in the next experiment, and this was not the case.

Such a set of null differences could have arisen

because emotional states do not have influences on the patterns of activation in the semantic network, or they could have arisen as a consequence of experimental limitations. The possible experimental limitations that could lead to null results will now be considered.

An obvious candidate for an explanation of the lack of consequences of emotional states on the information processing of emotion relevant material, is the possible lack of an emotional state. If the difference in emotion rating between the median split groups on the scales which correspond to the induction procedures, seems to be psychologically insignificant, then it is probable that the lack of apparent influence of emotion on the activity of the semantic network, reflects the fact that subjects are indistinguishable in terms of their emotional states. A median split revealed that the two groups differed by two scale units in the case of fear, ($M1 = .33$, $M2 = 2.33$), and also by two scale units in the case of joy ($M1 = 1.72$, $M2 = 3.77$). In terms of the verbal labels included with the rating scales (see appendix 2), two scale units could encompass the distance between a rating of 'not at all', to bordering on a 'moderately' rating of the emotional quality concerned (this applies to the fear scales). In the case of the joy scales the difference between the means of the highest and lowest groups, encompasses the distance from just below 'moderately', to the high end of 'moderately'. It thus seems, that serious doubts can be raised as to whether there was a sufficient range of intensities of emotional states to allow marked processing differences between the subjects at different ends of the intensity

continuum.

This narrow range of emotional intensities is obviously partly the consequence of a less than successful induction of emotional states in subjects. The range of emotional intensity might possibly have been improved had a more antagonistic pair of emotions (such as joy and distress), been chosen for the emotions to be induced. However, the use of imagery and recall as mood altering processes seemed well justified in the light of evidence that imagery is a very effective way of altering affective states (Lang 1979, Izard 1972, Masters, Barden, Ford 1979). It is also possible that the experimental task of naming the colour of coloured words, acted to dampen the extent of any affect change. A second factor which might act against the evidencing of semantic network activation by affect, is the induction procedure itself. The worst possible induction procedure would involve subjects seeing those words which they would be required to name later during the experiment. The reason that such a procedure would be undesirable, is that it is likely to result in some residual activation for the parts of the semantic network that correspond to the early induction words. (The procedures that employ word lists in order to induce mood states are those based on the work of Velten, 1968). That an elevation in activation is likely, and could be quite enduring is evidenced by studies such as those of Warren (1977), Durso and Johnson (1979), in which the activation from a previous stimulus presentation has consequences for the processing of a later stimulus, as much as 50 trials later (in the Durso and Johnson example). Thus, the presentation of words of a particular

emotional tone in order to induce a congruent mood state, could produce an artifactual relationship between mood state and semantic network activity as measured by a Warren task. It was for that reason that an imagery based induction procedure was preferred to the Velten technique. The lack of a significant Group x Category interaction shows that the reaction times in colour naming are not influenced by group-stimulus congruence. This suggests that the possible artifact discussed above did not arise in spite of the subjects often using emotional category terms in their responding to the TAT stimuli.

There is however, another possible influence of the story telling induction procedure. It might act to inhibit the processing of emotion words that have been used in the story telling. Evidence for this possibility comes from the Durso and Johnson (1979) Study, where at zero lag between picture prime and to-be-spoken word, there was actually a reaction time increase of 37 msec compared with the condition where there was no picture prime to the word. A study by Kraut, Smothergill and Mitchell (1981), has shown that reaction time to word stimuli is a joint function of level of alertness (raised by novel stimuli), and of the encoding facilitation enabled by familiarity with the word. Thus, a novel word as a warning signal produces a faster reaction time to a speeded choice task, than a familiar word.

In the case of this experiment, the recent use of words in the story telling phase would most likely mean that there was a decrement in the alerting produced by the same words appearing during the Warren task phase. At the

same time, there is evidence that encoding facilitation as a consequence of stimulus familiarity does not accrue across modalities (Winnick & Daniel, 1970; Warren & Morton, 1982). It is therefore possible, that where the emotion induction procedure was successful in inducing different levels of an emotion between groups, that the decrease in processing efficiency associated with the alerting decrement caused by familiarity with the lexical and semantic domain of the emotion concerned, (brought about by the induction procedure), counteracts any changes brought about by the activation emotion nodes. Such a criticism applies in the case of the present experiment, only when the induction procedure resulted in appreciable changes between groups, but it is a criticism that could be leveled at experiments such as those by Durso and Johnson (1979), and Warren and Morton (1982), without reservation. It calls into question the accounts of such experiments which tend to concentrate on pathway activation processes only.

Another possibility, raised by the discussion in the previous paragraph, is that the repetition of words, and conceptual domains during the course of the experiment, produces a substantial increase in the level of activation for all subjects. If this occurred the activation of the semantic network via emotion would be relatively very minor, and the influence of a subject's emotional state on information processing might be swamped.

There is some reason to suspect that this might have occurred in the present experiment, in that unlike the original series of experiments by Warren (1972, 1974), the present experiment utilises only eight categories as primes

but has four repetitions of each target word during the course of the experiment. The effect of a number of presentations, is to increase the activation of the portion of the semantic network associated with the conceptual domain of the words presented, and make the amount of alerting to a stimulus from that domain less. Thus, under such circumstances, a sizeable component of the reaction times would be contributed by alerting, and only a miniscule amount by the encoding facilitation of the preceding prime.

Such an interpretation is consistent with the significant effect for Validity, and the surprising finding that the mean reaction times were larger when there was an invalid relation between cue and target, (with the two words having no common 'emotional', or 'nonemotional' designation). The momentary alerting enjoyed by the colour word which differs from the priming to-be-remembered word maximally, will result in a greater allocation of processing resources to the target word, and consequently will result in a larger amount of interference with the colour naming.

The three possible explanations of the lack of a significant influence of subject emotionality on the processing of information of an emotional nature, could all hold to some extent, and they are not advanced as competing explanations. The experiment has shed no light on how subject emotional states interact with different emotional information, but it is still possible to address questions of a more general nature-on how stimulus materials are processed when they are of the type used in the experiment (basically emotional and nonemotional materials).

B) Differences Between Stimulus Conditions

One very interesting result, was the slower reaction time when abstract emotional words were targets, than when concrete emotional words were targets. The explanation for this is to be found in the types of priming stimulus that the subject had to remember (in comparison to the type of priming stimulus in the case of nonemotional words). The priming stimuli of the emotional kind were labels of the four categories of emotional words, while those priming stimuli that were non emotional, were exemplars from the four categories of neutral words. The abstractness or concreteness of the neutral words was constant within categories (that is, there were concrete categories - e.g. fruit, and abstract categories - e.g. time). Within each emotional category, there were four target words possible, two of which were abstract, and two of which were more concrete (prototypically emotion producing). Thus, the greater level of activation which might have accrued to those words representing conceptual levels similar to the priming words will result in a more significant interference, when it comes to colour naming. The result indicating a reaction time cost to abstract emotional words, suggests the possibility that the semantic network, as well as being associative in the sense that likely associates are activated, is specific in the sense that it is more likely to produce activation at a particular level of the network.

This result is compatible with experiments by Jorg and Horman (1978) which show that the verbal label accompanying a picture apparently affects the level at which subjects process that picture. Secondly, it is compatible with a

study of a picture-word analogue of the Stroop task by Lupker and Katz (1981), who showed that most of the interference in such a task, occurs when the interfering stimulus is at the same level (category level rather than exemplar level in their experiment 2), as the level at which the decision of which is the correct response must be made. Thirdly, the much cited result of Potter and Faulconer (1975), that pictures require more time to name, and less time to categorise than words suggests that there are certain classes of stimuli where activation may accrue most rapidly at a conceptually high level of the semantic network.

The most perplexing result perhaps was the highly significant interaction between the emotion of the priming words, and their content. Basically this has to be interpreted as a consequence of the widely divergent reaction time to trials which involved the to-be-remembered word coming from the only positive emotion category; that of joy. It is not obvious why prime words taken from this positive emotion category should prove especially disruptive, but it is likely that the reason is not to be found in patterns of network activity caused by the joy prime. If network activity was the cause, then the semantic category 'joy', being least predictive of the emotion categories, (in that it is the only category of positive affect), should interfere less with colour naming of target emotional words than words taken from the other negative emotional categories. An explanation in terms of the alerting consequence being greater in the case of emotion precues (greater alerting in going from positive primes to negative targets than vice versa) might be advanced, but in the absence of other

evidence that might confirm or deny such a suggestion, the result will not be considered further here.

Overall then, the results of experiment I do not provide support for an interpretation of emotion as acting on the semantic network. Indeed, the results seem best interpreted within a framework that has it that the most significant form of activation caused by a precue is a nonspecific activation associated with the alerting value of the target stimulus, rather than a specific pattern of activation in the semantic network.

This might explain why the present experiment failed to obtain a pattern of results similar to Warren's (1972). The only aspect of Warren's results that was replicated by the current experiment was the faster reaction times when X's were precues. Other details of the present procedure might also have contributed to the replication failure; the present procedure used only one to be remembered word (Warren used three); the use of abstract category names as primes (Warren used category names as targets). The use of category names as cues could be critical, because Warren (1974) shows the colour naming interference does not occur amongst backward associates.

The kind of experiment used here, while being desirable in terms of avoiding production biasing effects, is not a simple measure of semantic network activation: response time will be affected by the alerting quality of the stimulus word, and residual activation from both the induction procedure and the previous words presented during the course of the experiment. An experiment by Warren (1977) has demonstrated that there are different consequences for the

naming latency of a target word, when the priming stimulus is an antonym or involves a sex shift. This result shows that there is not necessarily a simple relationship between prime-target relatedness, and processing/production benefits, (although most studies which employ lexical decision tasks can be explained in terms of automatic activation benefits when prime-target predictability is not too high (c.f. Posner, 1982)).

There is also data from Elmes, Dye and Herdelin (1983) which show a very interesting relationship between word emotionality and word repetition interval: neutral words are rated more pleasant if their presentation and representation is widely spaced, whereas the same relationship is not discernable with emotional words. The result, in terms of recall is that massed repetition does not produce as large recall benefits as spaced repetition in the case of neutral words, but the recall of emotional words shows the same repetition benefits for zero spaced words, as for words with a space of eight other words between repetitions. This example provides converging evidence that results for emotionally significant and emotionally nonsignificant words under repetition, (and presumably associative conditions), are not the same and a one factor explanation of experiments in which the emotionality of stimulus material is varied (along with other experimental variations), is not tenable.

The classic colour naming interference method as formulated by Warren has not proved useful in demonstrating prime caused activation of the semantic network. The discussion of the correlational and ANOVA analyses has pointed out that the priming stimulus may produce complicated

effects. In the next experiment, the priming stimulus was not used, and so some of the problems of the current procedure were overcome.

Experiment II

The second experiment deviated from the classic Warren paradigm, in that the subject had no word to remember, prior to colour naming. It was thus hoped that a less contaminated measure of the consequence of emotion on information processing might be obtained. Any activation of the semantic network via emotion will be the only source of reaction time differences between neutral and emotional colour word targets, whereas in experiment I, prime-target relationships were also a source of activation, and these might have proved intense enough to swamp any effect arising from an interaction between the subject's emotional state and the stimulus material. The second experiment is a more direct test for activation produced by emotion within the semantic network.

The second experiment also included other stimuli that had a validity relationship with the target stimulus. This time the relations were between the target colour word, and a distracting flanker stimulus which appeared simultaneously with the target colour word, flanking it above and below written in colours different to that of the target. This experiment is a Stroop version of an experiment by Shaffer and La Berge (1979), which showed that the semantic information of flanking distractor words, is processed automatically and seems to interfere with the processing of same response targets. By including flanker words,

the second experiment looks for evidence of the effect of emotion on information processing outside of the attentional focus. Thus, the second experiment tests for the influence of emotion on the semantic network by measuring the interference that arises from unattended, as well as attended information channels.

Method Experiment 2

Subjects: The same group of 24 undergraduate students that took part in experiment 1, also took part in experiment 2, which was run as part of one continuous session which encompassed three experiments.

Stimulus Materials and Design

The lists for the second experiment, were similar to those for experiment I. They were composed of a word designated as the target word, and another word designated as the distractor word. Again, the experiment was computer controlled, with the same timing and presentation methods as were outlined in experiment I.

The major difference in experiment II, was that the target word was flanked on both sides by distractor words (both distractor words were identical except in colour). Thus, the subject saw three words and had to name the colour of the middle word. Experiment I's prime words were now the distractor words.

As before, TAT stimuli were used as stimuli for emotion laden stories.

Procedure

The procedure was identical to that outlined for experiment I, except that the 'priming' stimulus was always a row of XXXX's, and this would be followed by a display comprising three words each in a different colour, with the subject required to name the colour of the middle word. At the end of experiment II, subjects filled in the second of the emotion rating scales discussed in the procedure section of experiment I.

Results

Correlations were computed between the emotion-times for each word category with the scores for the four DES scales. As in the previous experiment, log times are used to calculate emotion-times. It was predicted that the greatest amount of interference would accrue to the correlations between corresponding emotion-times and emotion scale scores, and so these correlations were examined first. The correlations are reported in Table (4-11).

Only one of the 12 correlations between corresponding emotion-times, and emotion rating scale scores was significant. In case the lack of relationship found, was a result of some distractors swamping the effect of the target, separate correlations between the emotion rating scores and the emotion times for each validity condition were performed. These correlations were not significant, not even for the condition where X's were the distracting stimuli.

A series of repeated measures ANOVA's with the design factors shown in Table (4-1) was conducted, to test the

effects of the emotionality of the materials used, the influence of distractors, and what categories were most distracting. As previously the analysis was performed using the multivariate approach to repeated measures using the SPSS MANOVA package (Hull and Nie, 1981).

Estimation of subject reaction times was achieved in two ways. Firstly, for the purposes of reporting data, mean reaction times for each of the 32 conditions were used (cutoffs at which data were rejected as being probably error contaminated were below 500 msec and above 2000 msec). The second estimate of subject reaction time was for the purposes of statistical analysis and was by taking 25% trimmed means for the sets of conditions defined by two factors. For instance, crossing the Emotion factor with the Validity factor, yields 2 x 4 conditions each of which will have sixteen data points. These data points were used to provide robust estimates of the subject reaction times for each ANOVA cell. With a considerably larger data base for providing the trimmed mean, the presence of an outlier was unlikely to produce contamination in the overall estimate of a subject's reaction time for a condition, and so cutoffs were not applied. Implicitly in doing separate analyses with two factor combinations, it was assumed that third and higher order interactions of stimulus factors were unlikely or uninterpretable, and that the cost of ignoring such factors was negligible in terms of error variance.

Mean reaction times for all groups, and all levels of the stimulus factors Emotion , Validity, and Category are provided in Table (4-13). Separate ANOVAs were performed

TABLE (4-11) CORRELATIONS BETWEEN EMOTION-TIMES (MSEC) AND CORRESPONDING RATING SCALE SCORES (EXP. II).

Scales administered after -	<u>Emotion Times</u>			
	Fear	Anger	Joy	Distress
Exp I	.05	.03	.16	.07
Exp II	.03	-.00	-.08	-.24
Exp III	-.35*	-.10	-.07	-.0

* $p < .05$ (One-tailed test)

TABLE (4-12) SIGNIFICANT AND NEAR SIGNIFICANT EFFECTS OF THE WORD STIMULI IN EXPERIMENT II.

(Within Subject Factors: Emotion, Validity)

<u>EFFECT</u>	<u>F RATIO</u>	<u>P</u>
Emotion	5.19	.035
List Group X Emotion	5.74	.028
List Group X Validity	3.64	.036

(Within Subject Factors: Emotion, Validity)

<u>EFFECT</u>	<u>F RATIO</u>	<u>P</u>
Category	3.95	.028
List Group X Emotion X Category	6.10	.004

(Within Subject Factors: Emotion, Abstractness)

<u>EFFECT</u>	<u>F RATIO</u>	<u>P</u>
List Group X Emotion X Abstractness	3.84	.066

TABLE (4-13) MEAN REACTION TIMES (MSEC) FOR MAIN STIMULUS
CONDITIONS EXP. II.

<u>Emotion</u>	<u>Category</u>	<u>Validity</u>	<u>X</u>	<u>S</u>
Emotional	Fear	XXXX	800.6	178.2
		VAL	792.6	167.4
		SE	806.6	176.0
		N	813.0	161.5
	Anger	XXXX	814.6	158.7
		VAL	877.5	209.9
		SE	842.5	183.8
		N	862.0	217.4
	Joy	XXXX	800.3	175.7
		VAL	797.6	166.8
		SE	804.2	195.2
		N	835.6	175.1
	Distress	XXXX	792.7	188.4
		VAL	840.0	191.9
		SE	825.1	201.1
		N	797.5	167.1

Table 4-13 continued on next page

Table 4-13 Continued

<u>Emotion</u>	<u>Category</u>	<u>Validity</u>	<u>X</u>	<u>S</u>
Nonemotional	Weather	XXXX	837.4	221.3
		VAL	832.4	195.2
		SE	784.4	163.0
		N	832.0	168.6
	Fruit	XXXX	803.6	148.7
		VAL	804.4	173.8
		SE	824.7	181.3
		N	790.6	149.6
	Time	XXXX	781.3	175.0
		VAL	804.6	173.4
		SE	793.7	167.8
		N	799.2	174.8
	Writing	XXXX	793.4	176.7
		VAL	798.4	161.7
		SE	821.4	188.1
		N	843.6	181.7

for the following factor combination pairs, crossed with the Induction Group and List Group between subject factors: (Emotion, Validity), (Emotion, Category), (Emotion, Abstractness), (Distractor Emotion, Distractor Category). Only the first two analysis combinations produced significant effects (apart from the effect for the emotionality of the material). The results of the first two ANOVAs are detailed in Table (4-12). The significant effect for Emotion arises because of an 11 msec difference between the mean reaction time to emotional colour words ($M = 805.5$) and the neutral colour words ($M = 794.5$). The means for the reaction times that led to the significant interaction between List Group and Validity factors are presented in Figure (4-3) and Table (4-15). It can be seen that only for the second list group did the X's as distractors produce different results from words as distractors. In this group, the X distractor condition was 25 msec faster than the average for the other three (word) distractor conditions.

The significant effect for Category is nonsensical since Category is a dummy variable that in conjunction with the Emotion factor distinguished the category of the stimulus word. It must be supposed that the significant Category effect arises because of the interaction between Category, Emotion and other experiment factors.

There was a significant effect for the interaction between the factors of Emotion, Category and List Group. Tables of the means for each of the two stimulus lists are provided in Table (4-17). Figure (4-4) graphs these means. It can be seen that for stimulus set II, there was a large difference between the times for the anger category, and

TABLE (4-15) REACTION TIMES FOR EMOTION AND VALIDITY
CONDITIONS FOR STIMULUS SETS I & II.

<u>Stimulus set I</u>						<u>Stimulus set II</u>					
	XXXX	VAL	SEM	N			XXXX	VAL	SEM	N	
E	811	800	812	810	808	E	786	817	803	805	803
N	811	800	823	793	809	N	760	798	781	782	780
X	811	800	818	802			773	808	792	794	

TABLE (4-16) REACTION TIMES FOR ALL CATEGORIES IN
EXPERIMENT II.

Fear	Anger	Joy	Distress	Weather	Fruit	Time	Literature
798	823	799	802	797	803	782	798

TABLE (4-17) REACTION TIMES (MSEC) FOR EMOTION AND CATEGORY CONDITIONS FOR LISTS I & II.

LIST I						LIST II					
<u>Category</u>						<u>Category</u>					
<u>Emotion</u>	C1	C2	C3	C4		<u>Emotion</u>	C1	C2	C3	C4	
E	798	808	812	811	807	E	797	838	782	793	803
N	805	834	786	813	809	N	790	773	778	783	781
	802	821	799	812			794	806	780	788	

FIGURE (4-3). NAMING LATENCIES FOR VALIDITY CONDITIONS (EXP2)

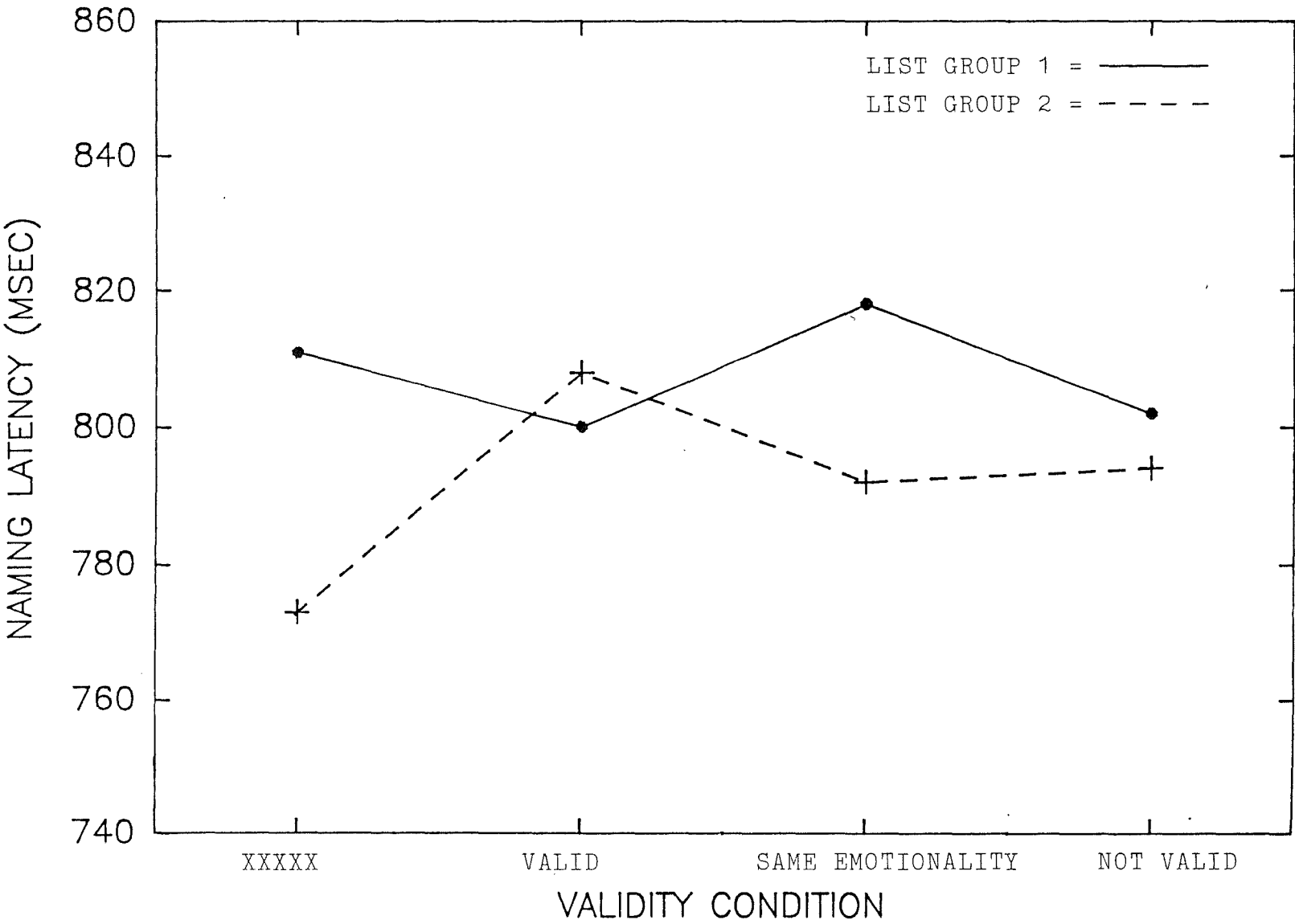
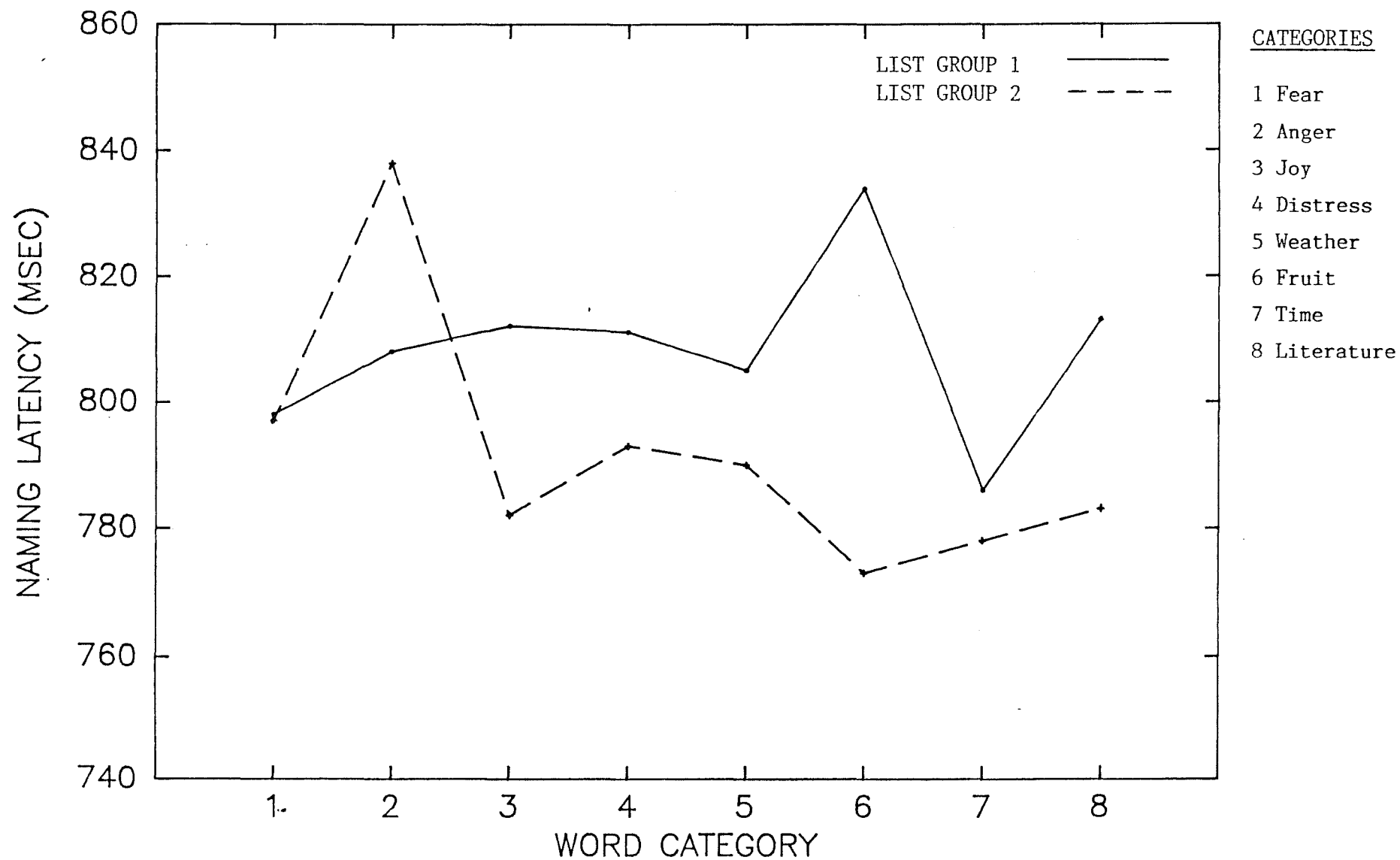


FIGURE (4-4). NAMING LATENCIES OF TARGET CATEGORIES (EXP2)



the other word categories. A series of repeated measure t-tests showed that the time taken for the anger category words was significantly more ($p < .05$) than for words of other categories for five out of seven possible contrasts. None of the other possible contrasts within the two lists was significant.

The appearance of a significant three way interaction that involves the List Group factor could have several explanations; it could arise because the two lists are not well matched at one or more emotion-category combinations; it could be a genuine statistical aberration that has arisen purely because of a fortuitous distribution of reaction times with respect to conditions; or, it could arise because the subjects in the blocks were not equivalent.

There is evidence pointing towards the third of these possibilities in the comparison of the data from Experiment I with that of the present experiment. Experiment II used as a stimulus set the word list not used in Experiment I. Thus there was a crossing of lists between Experiments I and II. If the cause of the interaction was that the lists were not matched, then a similar pattern of results to those of Experiment II would be expected for each list in Experiment I. That is, in Experiment I the first List Group should show the elevation of reaction times for emotional words which the second List Group has in the present case. In fact the almost significant List Group x Emotion interaction in the first experiment has the List group 2 again showing elevated reaction times for emotional target words. The first List Group actually shows faster reaction times for emotional words. Thus, we can rule out the possibility

that the interactions involving List Group are because of the stimulus sets. Instead, the significant interactions involving List Group must be attributed to differences in information processing between the two subject groups. The results from the two experiments, dividing the subjects by which List group they were in, appears in Table (4-18).

To see whether the two groups receiving different stimulus material could be differentiated in terms of self report measures, a series of Mann-Whitney U tests between the list groups was done on the emotion rating scale scores for fear, anger, joy, distress and the scale total for the scales completed at the end of Experiment I, at the end of Experiment II, and also for the characteristic emotions scale at the end of Experiment III. Only the scale total measure of the characteristic emotions scale differentiated the groups to a statistically significant level ($U = 37.5$ $p < .05$), while state joy scale after Experiment I approached significance ($U = 40.5$ $p < .07$). An assessment of whether these score differences could explain the differences that appeared between the groups receiving the different stimulus lists was achieved by reexamining the correlations between the emotion-times with the emotion scale scores. These correlations are presented in Table (4-19), and show that there is a large highly significant negative correlation between the anger emotion-times and how happy subjects rated themselves. This negative correlation also occurred between the anger emotion-time and the overall level of emotionality typical of subjects, although it was not quite significant ($p < .06$). It should be noted that the correlations between the anger category emotion-time and the joy ratings

TABLE (4-18) REACTION TIMES (MSEC) FOR EMOTIONAL AND NEUTRAL COLOUR WORDS IN EXPERIMENTS I & II.

	<u>Emotion</u>	<u>Exp. I</u>	<u>Exp. II</u>
List Group I	E	878	807
	N	889	809
List Group II	E	862	803
	N	851	781

TABLE (4-19) CORRELATIONS BETWEEN EMOTION-TIMES WITH (SELECTED) EMOTION RATING SCALES.

EMOTION SCALE	<u>EMOTION TIME</u>			
	Fear	Anger	Joy	Distress
Joy State (Exp. I)	.1459	-.7338*	.1565	-.2794
Total Emotions	-.042	-.3259	.0132	-.2587

*
* $p < .01$

TABLE (4-20) CORRELATIONS BETWEEN FEAR AND JOY SCALES AND MEAN REACTION TIME. (EXPERIMENTS I AND II)

TIME	EXP. I		EXP. II		EXP. III (Trait-scale)	
	Fear	Joy	Fear	Joy	Fear	Joy
EXP I	.25	-.258	.004	-.322	.498*	-.185
EXP II	.061	-.264	.010	-.419*	.410*	-.373*

(* = $p < .05$, * $p < .01$) one-tailed tests.

after Experiment II, and typical joy state rating (Experiment III) were also significant ($r = -.35$ $p < .05$, $r = -.46$ $p < .05$ respectively), but that these correlations can be accounted for by the correlations between the joy state scale after Experiment I and these two scales ($r_{12} = .71$, $r_{13} = .51$). As a further check that emotion state scores are not spuriously correlating with the emotion-time for anger, a comparison was made of the correlation of the two emotion scales that are being considered, with the nearest equivalent condition of experiment I - which had the XXXX's to be remembered followed by a display consisting of a single anger category colour word. The correlation with the joy state rating was $r = -.37$ ($p < .05$), while that with the overall typical emotionality measure was $r = .11$. Thus, there is some evidence that for at least the joy state after Experiment I, there is an influence on the processing of anger related information. (In fact, the anger category emotion time also correlated with the typical level of overall emotionality ($r = -.36$, $p < .05$)).

In a quest for an information processing minitypology (Kareev, 1982), a further analysis of the data of experiments 1 and 2 was conducted using cluster analysis. These analyses are considered in a separate section, at the end of this chapter.

One other table included among the results of this chapter is the table of correlations between the Fear and Joy scale, and the subject's mean reaction times. In view of previous experimentation that has demonstrated a relationship between mood and decision time (e.g. Velten 1968), if the scales were a valid and reliable measure of emotion

intensity, some significant correlations should occur between scale scores and reaction time. The correlations appear in Table (4-20), and are for both experiments I and II. There are several significant correlations, and these will be discussed in the final section.

Discussion

Experiment II constituted a more direct test of whether the semantic network is affected by the emotional state of the subject, than did Experiment I. There were no priming to-be-remembered words, so that subjects could gain no advantage from expectancies of what the next stimulus might be. This should have reduced the extent that the semantic network was activated by sources apart from the stimulus that was being processed in the present trial, and the emotional state activation of the semantic network. The fact that only fear scale scores correlated significantly with the emotion-times for the corresponding fear category in the experiment was an initially disappointing result. This correlation in fact goes against what would be predicted by semantic network activation by the emotion of fear, because being negative, it indicates that there is less interference in colour naming a fear word when a subject is characterised by chronic fear. Such a result might be predicted by the perceptual defense literature (reviewed in Dixon, 1981), but it is more likely to have arisen by chance given that it was the only significant correlation in twelve correlations. Thus, at first sight the second experiment provides no support for Bower's (1981) theory put forward to explain the effects of emotion on memory.

The fortuitous emergence of a significant interaction between groups that received different word lists in Experiment II, was shown to have arisen as a consequence of differences between subject groups rather than as a consequence of the different word lists. This was demonstrated by showing that the group that received stimulus List 1 in Experiment II, and previously had received stimulus List 2 in Experiment I had the same tendency towards a slower response time to emotional than non emotional colour words, in both experiments despite the change in lists. The differences that the groups exhibited in terms of emotional states was in the amount of positive affect that they were feeling at the time of the experiment, and in the characteristic overall level of emotion. Both emotional scales on which the groups differed had significant or near significant correlations with the emotion-times for at least the corresponding anger category, and inspection of Table (4-17) reveals that this category is the one with the most pronounced difference (relative to all control categories) in the group receiving List 2.

An hypothesis which describes the effect of the emotional states of people on their tendency to automatically process information and admit it to awareness is -
"The more relaxed and happy people are, the less likely they are to admit into the limited capacity system the automatic outputs of emotion system information processing of information relating to threat.". Such a hypothesis makes obvious sense from an evolutionary point of view. It is going to be an advantage to an organism that ranges across many and varied environments to be able to adopt

information processing strategies specific to the optimisation of behaviour within particular environments, and have the ability to shift processing strategy when the environmental boundary is crossed. However, while the results from experiment 2 suggest this as a viable hypothesis, it requires confirmation from the results of other experiments. The re-examination of the results from Experiment I provided a valuable piece of corroborative evidence in finding the same significant correlations for the anger emotion-time in the nearest equivalent condition to the kind of conditions in Experiment II. However, the results of Experiment III will allow final assessment of whether there is good evidence for such an effect of emotion on information processing.

Overall, the anger category colour words were responded to more slowly than words taken from the other seven categories. One explanation is anger words were more self-relevant than those of other categories, and were admitted to the limited capacity system (Duncan 1980) more than words from other categories. As a consequence of admittance to the limited capacity system, (which would appear to be connected to response processes—Duncan, 1980; La Berge, 1981), interference with the colour naming response occurs.

The explanation of colour naming interference in terms of word self-relevance is consistent with results from experiments conducted by Geller and Shaver (1976). They showed that self-relevant words such as 'disliked, proud, error, failure, capable, impotent' produced more interference with colour naming than neutral words equated for frequency symbols and part of speech. In Geller and Shaver's framework

the emotional words in the present experiment should be self-relevant. The significantly longer reaction time to colour name these words compared to neutral words, confirms the result they obtained in experiment I.

The results of Geller and Shaver also indicated that interference that subjects experience because of self-relevant information, can be altered by a simple manipulation (the presence of a mirror and camera in their experiments). That subject states can affect the extent that information is admitted into conscious awareness, is totally compatible with the correlational results discussed in this chapter. An alternative explanation to that put forward by Geller and Shaver is that the introduction of the mirror and camera, had an influence on situationally induced emotion, which produced the larger amount of interference. Shearer and Carver (1982) provide evidence that self awareness manipulations can alter the level of felt affect.

One puzzling effect that the present experiment revealed, was that only for List Group 2 was there evidence that flanking X's were less interfering than flanking words. Kahneman and Chajczyk (1983) in another stroop type experiment employed flanking words, found that X's produce significantly less colour naming interference than do neutral word flankers. Thus, the results for group 2 are what are expected by the Kahneman and Chajczyk study. Perhaps the lack of such a difference in group 2 can be ascribed to a type II error. There is no obvious alternative explanation.

Overall the finding that happiness is negatively correlated with interference from anger words is suggestive

of an influence of emotion on the semantic network. The result is what would be expected if there is an inhibitory connection between happiness and anger nodes in the network as suggested by Bower (1981). But if the result is of significance, the reservations of the previous experiment with regard to the range of emotion being insufficient, need re-examining. The correlations between the emotion scales of relevance in this experiment and overall reaction times indicate that the previous reservations might have been too cautious. The correlations between characteristic affect states and reaction times suggest that the emotional states that the subjects bring into the experiment vary sufficiently to have an influence on some response processes. Accordingly, the earlier reservation might be open to question.

The results reported here are suggestive, not conclusive. The relationship between anger emotion-time and the joy state measured early in the experiment was not expected, and it might well be spurious. Final assessment of what the findings from Experiment II indicate will be left until after discussing Experiment III. Then, the consistency of results among the experiments will be examined, and the extent of the overall evidence assessed.

Experiment III

If for the moment, the possibility of a correlation between emotion-time and a person's emotional state is admitted (at least for the anger category stimuli), then there are two obvious explanations for such results. Firstly, such correlations could arise because emotional

states produce different resting levels of activation within the semantic network. The different resting levels of activation will enhance and inhibit the processing of emotional words. This explanation is the one advanced by Bower (1981) for his demonstrations of emotion state-dependent learning.

An alternative explanation of emotion-time, emotion state correlations is in terms of attention allocation policy. This suggests that the greater reaction times to emotional colour words in Experiment II, comes about because a greater amount of attentional resource (c.f. Kahneman, 1973; Navon & Gopher, 1979) is allocated to the emotional colour word. The greater allocation of attentional resource means that there is a higher probability of the emotion colour word being analysed to a phonemic level where it will interfere with the production of the colour name. It is assumed that attention allocation policy will be more biased towards emotional inputs the more intense the emotional state. This last assumption provides the explanation for the emotion-time, emotion state correlations.

The present experiment provides a test of the attention allocation explanation of the earlier results. In the experiment, subjects received a central row of X's flanked by a neutral, and an emotional word. In one stimulus condition the neutral word is in a colour different to the central X's, and in another stimulus condition the emotional word differs in colour from the X's. If subject's emotional states produce differences in attention allocation, then very angry subjects (for example), will allocate more attention to the emotional words from the anger category,

than to neutral words. The greater attention allocation to the emotion word in the visual field, should have a different influence on reaction time depending upon whether it is the same or a different colour from the central X's.

The present experiment looks for an attention allocation bias towards emotional words. This bias is likely to become more pronounced with any increase in the intensity of an emotional state.

The logic of the experiment is as follows. The attentional bias towards emotion relevant information will mean an increased level of activation accruing to all features composing an emotional stimulus. Thus, if the colour of the emotional word is in conflict with that of the target X's, the additional conflict between colour codes will result in an increase in colour-naming time. If on the other hand, the colour of the emotional word is the same as that of the target X's, then a colour naming time decrease should be the consequence of the agreement between the colour codes.

Thus, attention allocation produced by emotional words can be measured by differencing the times between the condition when the emotion word's colour matches the target colour, and the condition where it does not. If attention allocation is a consequence of emotion, there should be a correlation between this difference and the intensity of the corresponding emotional state.

Method

Subjects: The same group of 24 undergraduate students who took part in experiments I and II, served in Experiment

III. The experiment started immediately after subjects had completed the emotion scale at the conclusion of Experiment II.

Stimulus Materials and Design

In Experiment III, the target for colour naming was a line of five X's, with distractor words positioned above and below. One of the distractor words was written in the same colour as the X's, and the other distractor word was written in a different colour to the X's. In the 64 trials in Experiment III, emotional and neutral words appeared an equal number of times above and below the target, and an equal number of times in the same, and a different colour to the target. Appendix 1 contains stimuli, and demonstrates the balancing of the target stimuli. The same list was used for subjects in List Groups 1 and 2. Words that were the same colour as the target X's for one group were a different colour (at the same list position) for the second stimulus group. Of course, words of a different colour to target X's in one list were of the same colour as the X's in the second list. The stimulus factors in the present experiment were: Colour (whether the emotional word was the same, or a different colour to the target stimulus), Category (the category of the emotional word).

The same group factors of Induction Group and List Group were used for this experiment.

In the results that follow, the difference between the condition with target and emotion word the same colour, and the condition where they were different is once again referred to as emotion-time. It is acknowledged that the

processes which cause the emotion-times of the present experiment might be quite different from those of Experiments I and II. However, since the term carries an implication that it is the general processing cost associated with the processing of emotional stimuli, it is retained here.

Results

The emotion-time measure was obtained by taking the natural log of the ratio of the reaction time in the condition with the emotional word a different colour to target X's, to the condition with the emotional word the same colour as the target.

$$\text{i.e. Emotion-time} = \text{Log (RT1/RT2)}$$

Where RT1 = X colour \neq Emotional word colour

and RT2 = X colour = Emotional word colour.

Table (4-24) reports the correlations between emotion-times and their corresponding emotion scale scores. The one significant correlation out of twelve testing for the influence of emotion on attention allocation is best regarded as Type I error.

The two stimulus factors Category and Colour were analysed along with the grouping factors of Induction Group and List Group by analysis of variance. The two significant effects are listed in Table (4-25). As well as these two significant effects the interaction List Group X Colour X Category also approached significance, and was significant by an alternative statistic to the multivariate F (Averaged $F = 3.0172$, $p < .04$).

Table (4-26) lists the mean reaction times for the subject groups that gave rise to the significant Induction

TABLE (4-24) EMOTION-TIMES (COLOUR DIFFERENT - COLOUR SAME)
CORRELATED WITH THE CORRESPONDING EMOTION SCALE MEASURE
(EXP. III)

Scales administered after -	<u>EMOTION TIMES</u>			
	Fear	Anger	Joy	Distress
Exp. I	-.15	.05	-.23	.24
Exp. II	-.15	-.21	-.29	.22
Exp. III	-.30	-.26	-.27	.41*

* $p < .05$ (one-tailed test)

TABLE (4-25) SIGNIFICANT AND NEAR SIGNIFICANT EFFECTS IN
EXPERIMENT III.

	<u>Effect</u>	<u>F Ratio</u>	<u>P</u>
	Induction X List	3.67	.046
	Induction X List X Colour X Category	2.467	.045

TABLE (4-26) MEAN REACTION TIMES (MSEC) FOR EACH GROUP.
(EXP. III)

	<u>INDUCTION GROUP</u>		
	Fear	Joy	Neutral
List Group 1	780	618	780
List Group 2	633	849	807
	707	734	793

TABLE (4-27) MEAN REACTION TIMES FOR EACH LIST GROUP IN EXPERIMENT III.

<u>List Group 1</u>					<u>List Group 2</u>				
CATEGORY					CATEGORY				
<u>Colour</u>	Fear	Anger	Joy	Distress	<u>Colour</u>	Fear	Anger	Joy	Distress
Diff	720	725	733	720	Diff	799	731	771	745
Same	732	719	735	721	Same	759	787	765	753
	726	722	734	720		770	759	768	749

TABLE (4-28) ANOVA TABLE FOR A SEPERATE ANALYSIS OF THE
ANGER CATEGORY REACTION TIMES. (EXP. III).

<u>Effect</u>	<u>F</u>	<u>df</u>	<u>P</u>
List Group	.38	22	.54
Colour	5.00	22	.035
List X Colour	8.12	22	.009

TABLE (4-29) CORRELATIONS OF THE DISCRIMINANT FUNCTION FOR
DISTINGUISHING LIST GROUPS 1 AND 2 WITH THE EMOTION-TIMES FOR
EACH CATEGORY. (EXPERIMENTS I, II & III).

	<u>Emotion-Time</u>			
	Fear	Anger	Joy	Distress
Exp. I	.09	-.30	.09	.17
Exp. II	.07	-.42*	-.33	-.001
Exp. III	-.10	-.12	-.30	.17

* $p < .05$ (two-tailed test)

Group X List Group interaction. It is evident from this table that there is a wide range of reaction times across the groups. There is no obvious manner in which the factor of Induction Group affects colour naming time.

The consistent lack of any effect involving the Induction Groups, and failure to find any effect for the mood inductions renders interpretation of interactions involving Induction Group problematic. Consequently, instead of interpreting the Induction X List X Category X Colour interaction, the marginally insignificant List Group X Colour X Category interaction was looked at. This interaction corresponds to the interaction involving the List Group factor in the last experiment. Table (4-27) contains the results for each of the stimulus groups. Again, as in earlier experiments, the conditions containing the anger category words produced marked differences between the groups. The second List Group obtained a 56 msec advantage for when the emotion word was written in a different colour to the target X's. The first List Group showed no evidence of such a pattern. The reaction times for anger category words were subjected to a separate ANOVA. Table (4-28) reports the results of this ANOVA.

Discussion

The third experiment sought to demonstrate an influence of emotion on spatial attention allocation. Unfortunately there was not a significant main effect for Colour. The hypothesis that emotional words produce a biasing in the allocation of attentional resource is not supported. Also, the failure to find a number of significant correlations

between emotion times and emotion scale scores means that there is no evidence for a relationship between emotional states and attention allocation.

The only evidence that emotion might be important in attention allocation was the significant interaction involving List Group X Colour X Category. The examination of the reaction times for the anger category revealed that the condition in which the emotional word was a different colour to the target X's, was significantly slower than when it was the same colour as the target X's. It was only the second List Group that showed this pattern of results. In terms of the predicted consequences of emotion on attention allocation, these results were in the opposite direction to what was expected. If the logic outlined in the introduction is followed, it has to be concluded that subjects in the second stimulus group allocated less attention to emotional words than to neutral words.

There is an alternative way of explaining the slower reaction times when the colour of the anger category word is the same colour as the target X's. If it is assumed that the visual field is rapidly segregated into relevant colour feature regions, then only when the emotion word is the same colour as the target X's, will it receive any processing. Consequently if emotion words are more interfering with colour naming than neutral words, there will be slower reaction times to the condition with their colour the same as the target X's. If this explanation holds, the experiment provides some evidence to support studies such as those of Treisman (1982), Carter (1982) which demonstrate the early segregation of the visual field on the basis of colour

features.

The fact that the List groups were involved in the interactions once again, suggests that there were differences in the way in which the two groups of subjects processed emotional information. However, the lack of significant correlations between anger emotion-time and the emotion scales that distinguished the two groups, means that there is no evidence for emotional differences between the groups being the cause of these results. The next section of the chapter uses multivariate methods in an attempt to discover the causes of the differences between subjects.

It should also be noted that the results of Experiment III might be a consequence of the joint action of both of the processes proposed. That is, both emotion caused attention allocation and colour caused attention allocation might be occurring. As these will produce opposite effects on reaction time, and the relative extent that they operate might vary between word categories, the interpretation of the results of this experiment becomes problematic.

Further Analysis

In order to determine what the difference between List groups was, the following multivariate analyses were performed.

- 1) A stepwise discriminant analysis on the emotion scale scores (for state and trait) was performed. The relationship of the discriminant function score to the emotion-times was then examined.
- 2) Cluster analyses were performed on the reaction time data of each experiment. This was a search for subject

minitypologies (Kareev, 1982).

3) The age and sex profiles of the two List groups were examined to see whether these factors were contributors to the differences between the groups.

Discriminant Analysis

The emotion scale scores were used to derive a discriminant function that would distinguish List group 1 from List group 2. The set of twelve scales measuring individual emotions was reduced to eight by obtaining the mean score for each subject for each emotion scale from the ratings taken after the first experiment, and taken after the second experiment. The subject's mean scores on each emotion scale are regarded as measurements of the subject's emotional states during the experiment. The other four scales in the discriminant analysis were those from the final rating period. These scores are regarded as measurements of the subject's emotional traits.

The discriminant analysis was stepwise, and employed the selection rule of minimizing Wilk's Lambda. After three steps, no unentered variables had F ratios greater than 1. The discriminant function obtained was:

$$D = -.199 (\text{Fear State}) + .240 (\text{Joy State}) + .390 (\text{Fear Trait})$$

The significance of this function using a Chi square test of Wilks Lambda (Overall & Klett 1972), is $p = .046$ for three discriminating variables. However, since eight variables were used to develop the function, it is not significant overall.

To ascertain whether this function can account for

the differences between the two groups in emotion-times, correlations between the discriminant function and emotion-times were performed for each of the three experiments. The correlations appear in Table (4-29). They show only one significant correlation; that between the discriminant function and the anger emotion-time in Experiment II. The correlation suggests that happy subjects with low fear states have large emotion-time components for anger category words. The sign of the corresponding correlations for Experiments I and II were the same.

If we consider that we obtained one significant correlation out of sixteen correlations, then the discriminant function cannot be said to explain the emotion-time data. However, in the category where the two groups most deviated from each other there is a ratio of one significant correlation to three. Accordingly the results can be taken as equivocal. While providing no strong evidence that the emotional states that distinguished the groups affected processing time, they do not completely rule out the possibility either.

Cluster Analysis

In accord with the suggestion of Kareev (1982) that we employ methods to distinguish the different ways that people respond in experiments, a cluster analysis was performed. It was hoped that the cluster analysis would reveal at least two 'minitypes', and that these minitypes could be distinguished in terms of their emotional states and traits.

The cluster analysis utilised the single linkage option

of the BMDP2M program. The program's procedure can be visualised as the incrementing of disks on each element until another element is touched. These touching elements are then made part of a cluster. The procedure continues until all elements have been joined in the one cluster. The method corresponds to the minimum method proposed by Johnson (1967).

A separate cluster analysis was performed for each of the three experiments. The analyses were performed using the within subject z-scores. In Experiments I and II, there are 32 within subject conditions (see Table (4-13)). Of these, only the sixteen associated with emotional categories were used (although all conditions were employed in calculating the within subject z-scores). Z-scores were employed to ensure that clustering was based upon the pattern of reaction times between conditions, and not just their absolute levels. The neutral word conditions were eliminated to prevent the formation of subject clusters based upon differences in reactions to neutral stimulus categories.

The output vertical tree diagrams for each experiment are found in Tables (4-30) to (4-32).

For the purposes of testing between clusters, it was decided that tests would only be performed if the smallest (of two) clusters contained at least 4 elements. Cluster membership was determined at the step immediately prior to the amalgamation of the two largest sets of elements. Using these criteria, only experiments II and III gave evidence of clusters.

The average emotional state scores, and average

TABLE (4-31) CLUSTER ANALYSIS OF EXPERIMENT II.

SUBJECT	1	2	1	1	1	1	2	2	1	2	1	1	1	2	1									
NUMBER	1	7	6	1	8	4	6	5	8	2	3	3	4	2	3	0	4	5	2	1	8	9	0	7

AMALG.

DISTANCE

[illegible]

TABLE (4-33) MEANS OF CLUSTER GROUPS IN EXPERIMENT 3.

	GP1	GP2
Fear State	1.5	3.45
Anger State	.5	1.82
Joy State	4.8	8.22
Distress State	1.91	4.13
Fear Typical	3.8	2.72
Anger Typical	4.5	2.27
Joy Typical	8.3	10.81
Distress Typical	5.5	5.72

TABLE (4-34) MEANS OF CLUSTER GROUPS ON EMOTION SCALES IN
EXPERIMENT 2.

	GP1	GP2
Fear State	3.1	3.8
Anger State	.5	3.3
Joy State	8	4.1
Distress State	3	4
Fear Typical	3.7	2.2
Anger Typical	4.0	2.6
Joy Typical	10.6	8.0
Distress Typical	6.3	4.2

emotional trait scores for each group are shown in Table (4-33) for Experiment II, and (4-34) for Experiment III. There was no significant difference between the groups on any emotional scale. However, for both Experiment II and Experiment III, the difference between the groups on the state happiness scores approached significance. In Experiment II; $F(1,15) = 3.963$, $p < .07$, and in Experiment III ; $F(1,15) = 3.716$, $p < .08$.

The lack of significant differences between the emotion scores of the cluster groups suggests that any minitypes revealed, are unrelated to differences in the subject's emotional characteristics. As well, since there is almost no overlap between the membership of the cluster groups between experiments II and III, this suggests that any minitypes are experiment specific. Thus, the cluster analysis failed to provide any evidence of an effect of emotion on the semantic network.

Age and Sex Profiles

It is possible that some characteristic of the subjects apart from their emotional characteristics produced the interactions involving the List Group factor. The sex, and ages of the two List groups were examined to see if they could account for the group differences.

The ages of the two groups did not differ significantly ($M1 = 20.66$ years, $M2 = 19.33$ years).

The proportion of males to females was 8 to 4 in group 1, and 5 to 7 in group 2. It is conceivable that the different ratio of males to females might account for the group differences, so an ANOVA was performed for each

experiment, with SEX as the grouping factor. No significant interaction involving SEX emerged, except for a CATEGORY X SEX interaction in Experiment II ($F(7,16) = 3.32, p < .03$). The CATEGORY variable in this analysis contained all eight categories of words, and an inspection of the category means revealed that males took longer for fruit category words than did females.

The lack of any SEX X EMOTION interactions means that sex can be eliminated as the cause of the processing differences between the List groups.

General Discussion

Taken together, the three experiments failed to provide any substantial support for Bower's (1981) theory of emotion. The predicted correlations between emotional states and their corresponding emotion-times (extra time taken to name a coloured word because of the extra interference from an emotional word), failed to eventuate.

The only evidence suggesting an effect of emotion on the semantic network is the interactions involving the List groups, and the anger category emotion-time. The List groups received different lists from each other, and the List Group factor was included in the design to check that the lists were adequately matched. However, as was argued in the discussion of Experiment II, the List Group interaction with the stimulus factors of Emotion and Category, could not be because of the lists, but must be because of the subjects. Experiment III confirmed this because in spite of the fact that all subjects received the same list of stimuli, there was still an interaction involving the List

Group factor for anger words.

The attempt to find an explanation for the difference between the List groups by using methods such as discriminant analysis did not produce useful answers. The groups were different on some emotion scales, but the correlations between emotion scale scores and emotion-times for anger, did not hold across experiments.

The failure of the significant correlations to generalise across experiments could have two causes. It could arise because the experiments involve fundamentally different processes, or it could arise because the correlations are spurious. There is good reason to argue for different processes between Experiments II and III. Experiment III was formulated as a means of measuring spatial allocation of attention, while Experiment II concentrated on measuring the activation of semantic memory. There was a significant correlation in Experiment I between anger emotion-time, and the joy state scale for the Validity condition most akin to the unprimed conditions in Experiment II. However in the light of no other replications of correlations, and no significant correlation between overall anger emotion-time and joy state in Experiment I, the probability is that this 'replication' is spurious.

The failure of the analysis of the correlations between emotion-times and emotion state scores to explain the List Group interactions with the stimulus factors, leaves a puzzle. However, the generality of these interactions across all experiments does have an important implication. It means that the Warren task can demonstrate consistent differences in processing style. The fact that these

differences were obtained most strongly in the case of anger category words does suggest an emotional influence on information processing styles. But that is all that can be said on the basis of the research reported here.

Does the failure to find a relationship between emotional state and semantic network activation count against Bower's theory? It would, if we were satisfied that the subjects displayed a sufficient range of emotions, and emotional intensities, and that the task was a reliable measure of semantic memory activation. We have already queried the first of these requirements. As for the second requirement, the recent work of Kraut et.al. (1981) on alerting, and Kahneman and Chajczyk (1983) on the stroop task, cast doubt on whether this task is a very pure measure of activity in semantic memory. Consequently the null results obtained do not count against Bower's theory.

In fact, the doubtful significance between anger emotion-time and joy states are what might be predicted by Bower's model. Since anger is antagonistic to happiness, a high level of happiness should inhibit the anger node, and anger related nodes in the semantic network.

Conclusion

The three experiments reported here provide some evidence of individual differences in the processing of emotional words. The experiments do not provide any clear indication of why these differences arise. In short, the experiments have provided no answers, but they have raised some questions. One of the questions, the influence of emotion on attention allocation, is looked at in the

subsequent experiments reported in the next chapter.

Chapter five: An investigation of the consequence of emotion on early attention allocation.

An issue which is to date unresearched, is the effect that emotional states have upon the allocation of attention. Some theorists (e.g. Klinger, 1982; Hamilton, 1980), have implicated attention in their theories of emotion and information processing, but none have produced empirical evidence linking attention and emotion. The studies that bear most upon this linkage, are those which show the effect of material with emotional content upon attention. For example Nielsen & Sarason (1981), showed that sexual content words produced more intrusion errors in a dichotic listening task. Bargh (1982) found self relevant information produced an attentional cost.

The experiments reported in this chapter, looked at attention and emotion from the point of view of the feature-integration theory of attention put forward by Treisman and Gelade (1980). This theory conceptualises attention as the 'glue' that binds together the outputs of various feature detectors. The analysis of elementary features is assumed to be automatic and occur in parallel. The integration of the feature outputs into a representation of the stimulus element requires a form of serial, limited capacity processing. Thus, by this analysis, attention is required for the perception of complex objects.

Treisman and her colleagues have obtained converging evidence for her theory, using at least three different experimental procedures. In one of these experiments, subjects were required to search for a target letter in a field of

distractor letters. Treisman and Gelade (1980), showed that in such a task, visual search for targets that could be defined in terms of a disjunctive feature (different in one particular feature from the rest of the display) occurs in parallel. In contrast a target that is defined by a conjunction of the features common to other members in the display had serial search times. (An example of a conjunctive target would be a 'red X', in a display composed of 'red U's', and 'green X's'.) The result in favour of the feature integration theory of attention, was that search times only increased with display size for conjunctive targets.

In one of the other experiments, it was shown that when attention was overloaded, illusory conjunctions of features occurred (Treisman & Schmidt, 1982). A last series of experiments (Treisman, 1982), demonstrated that where subjects had to search for the target stimulus, in a set of uniform stimulus groups in the display, search across groups was serial, but search within groups occurred in parallel.

The present experiments asked whether in a task involving visual search, the feature integration process commences with the regions of the stimulus field containing features of emotional significance. It was predicted that for experiments such as the search task reported above, emotion should bias attention allocation so that reaction times to targets in emotionally relevant regions of a stimulus field, should be faster than for other regions.

The present experiments were formulated bearing in mind the reservations (expressed in the last chapter) about the success of artificial emotion induction procedures. An attempt was made to utilise in the laboratory, an environment

which has been shown to have affective consequences in everyday life. The subjects in these experiments were engaged in a gambling game where the stimulus array that was searched, contained information pertaining to the outcome of the current gamble. This environment allowed the manipulation of mood states to be effected by the stimulus set of the experiment. Thus, there was no contrived mood induction phase in these experiments; mood induction was continued throughout the experiment.

Experiment I

The first experiment employed groups of letters, one of which contained an odd letter which the subject had to name. Treisman (1982) had found that under such circumstances, serial search results. The question of interest was whether the target stimulus would be more rapidly detected when located in letters that signify a win, or when located amongst letters associated with a loss. It was predicted that for subjects who were happy, the target would be more rapidly detected amongst letters associated with wins, than amongst letters associated with losses. The reverse of this should hold when the subjects were unhappy.

Figure (5-1) Stimulus for Experiment I

TT	XX	XX	XX
TT	XX	XX	XX
XX	TT	TT	TT
XX	TT	TK	TT
TT	XX	TT	XX
TT	XX	TT	XX
XX	TT	XX	TT
XX	TT	XX	TT

An example stimulus array with target group T, distractor group X, and letter K as the target.

Method

Subjects: Subjects were thirty undergraduate students attending the University of Canterbury. The subjects were recruited to take part in "research on gambling" for which they were told that they would be staked \$4, and get to keep their winnings/losings.

Stimulus Materials and Design

Subjects had to perform a visual search task that involved finding an odd letter out in one of a group of letters. There were sixteen letter groups altogether, with only one being nonhomogeneous. The nonhomogeneous group contained a single different letter, and subjects were required to name this different letter as rapidly as they

could. All sixteen groups in the visual array were composed of four letters.

The visual array subtended a visual angle of $10^{\circ} \times 10^{\circ}$. Letter groups subtended a visual range of $2^{\circ} \times 2^{\circ}$, and individual letters subtended a visual angle of 1° (approximately). The visual array was displayed in white bold face capitals on a Kaga (Model KS14P) colour monitor connected in an Apple II plus computer.

A visual array was always composed of two kinds of letter groups. Each of the two kinds of letters making up the letter groups were the elements in eight out of the sixteen letter groups in an array. The kinds of letter groups were (T, X, U, A). Figure (5-1) provides an example stimulus array.

The target letter which the subject had to name was one of the letters (D, F, G, J, K, L, N, P, S). The target letter could appear in any of the letter groups in a stimulus array. It could occupy any one of the four letter positions within the group that it was located in. The target letter was the means whereby gamble outcome was signalled; it changed to a colour after the subject made a response and if this matched the colour which the subject had chosen to stake on, the subject won. The subject always had a 'choice' between the colour green and the colour purple on each trial. There was a fifty percent chance of choosing the correct colour.

At this point, we describe the nature of the gambling environment since this is necessary for defining the stimulus conditions.

TABLE (5-1) TABLE OF AMOUNTS WON/LOST WHEN TARGET LETTER LOCATED IN VARIOUS GROUPS

Target located in letter group	<u>Significant Stimulus Groups</u>		<u>Non Significant Stimulus Group</u>	
	Subjects's colour choice		Subjects colour choice	
	Correct	Wrong	Correct	Incorrect
T (Friend)	+S	0	+S	-S
X (Enemy)	0	-S	+S	-S
U (Neutral)	+2	-2	+S	-S
A (Neutral)	+2	-2	+S	-S

(S is the stake chosen by the subject for the current gamble. The minimum level on a trial ranged from 4 cents to 30 cents.)

The Nature of the Gambling Environment¹

Subjects gambled in a game which involved choosing one colour out of two alternatives which were offered on any one trial. Prior to their choosing, subjects were offered a choice between two stakes which differed in value by 4cents. After these decisions were made, a trial commenced ending in the target stimulus turning a shade that was one of the colour alternatives offered earlier. There were several possible outcome alternatives contingent on; (i) whether the subject had indeed chosen the display colour; (ii) the letter group in the display that the target letter appeared in. Assuming that the subject chose stake S, and colour C, then the outcomes in the Table (5-1) were possible depending on what letter group the target was located in.

It is clear from the table that target letter groups could be designated as friendly (T groups since it is not possible to lose), enemy groups (X groups since it is not possible to win), and neutral groups (A, U groups since the amounts involved are not of much consequence, and winning and losing are possible). Subjects were encouraged to think of letter groups as friends, enemies and neutrals. This designation was pointed out to them before they commenced practice. A check was made after practice that subjects had correctly remembered group designation, and were in fact aware of the outcome consequences of the letter group that the target was found in.

After each trial, the outcome was displayed on a screen in the form of the message "You have won/lost 'S' cents".

Prior to choosing the next stake, the screen displayed the current level of the subject's monetary resources. Subject

¹ This describes the environment for subjects in the 'significant stimulus groups. These subjects were also either taxed or rewarded periodically (see page 247).

TABLE (5-2) TABLE OF STIMULUS ARRAY CONDITIONS FOR
EXPERIMENT I SHOWING AFFECT LEVELS

<u>Target Group</u>	<u>Distractor Group</u>			
	T	X	U	A
T (Friend)		(+-)	(+0)	(+0)
X (Enemy)	(-+)		(-0)	(-0)
U (Neutral)	(0+)	(0-)		(00)
A (Neutral)	(0+)	(0-)	(00)	

(+ = affectively positive letter, - = affectively negative letter, 0 = affectively neutral letter. The first symbol inside the brackets refers to the target letter, and the second symbol refers to the distractor letter).

resources started with a 'stake' of \$4.00 thereafter it was dependent on how well the outcomes had been of earlier trials. Subjects were told that they had an initial amount of \$4.00 and could walk away from the session with that amount plus whatever they won, or minus whatever they lost. The level of stake choices varied between 4 cents and 30 cents (for the lower of the two stake choices offered - the higher stake choice was worth 4 cents more). The effect of offering only limited choice in terms of how much a subject might stake, was to ensure that the initial sum of \$4.00 would be sufficient to cover the total of 120 trials that a subject would play.

Array Conditions

The four kinds of letter groups available as distractors, crossed with the four kinds of letter groups available as carriers of the target letter meant that sixteen display conditions were possible. Of these, four were not of interest as the target and distractor groups were identical, and no attention allocation bias could be measured by these array conditions. The twelve remaining display conditions are shown in Table (5-2). It can be seen from the table that the conditions can be classified by whether the target group and distractor group letters are neutral, friendly, or enemy. The reason the letter groups have obtained their classifications is because the payoff and costs of successful and unsuccessful gambles is contingent upon which letter group the target letter is located in. This has already been discussed in the previous section, and Table (5-1) contains the contingencies.

A total of 120 stimulus arrays were presented, with there being two presentations of every array condition within each 24 trial block. Every trial had an associated stake choice, and the stake choices were shuffled so that the total amount that could be staked in any 24 trial block was always the same. Within each 24 trial block the stimulus array conditions were shuffled so as not to be predictable. Over the total of 120 trials, the amount that could be staked was the same for all stimulus array conditions. The same 120 stimulus arrays, in the same order were presented for every subject thus ensuring that differences in search times between subjects could be attributed to subject differences, and subject state differences. However, the outcome of the gamble associated with any one trial, and thereby with any one stimulus array, was not fixed. The gamble was genuine. This was achieved by having one of the two colour options offered to the subject to bet on, chosen by the computer randomly prior to the subject's choice.

The twelve conditions of stimulus array lend themselves to the creation of a set of three composite difference scores. These difference scores were decided on prior to the experiment and were independent of each other. (As pointed out in Cook & Campbell (1979), the error variance in *gain score* ANOVA is given by—

$$\text{Var}(\text{error}) = \text{Var}(X_1) + \text{Var}(X_2) - 2 \text{Cov}(X_1, X_2)$$

Thus, in the case of the present reaction time experiment, assuming that $\text{Var}(X_1) = \text{Var}(X_2)$ then

$$\text{Var}(\text{error}) = 2\text{Var}(X_1) - 2 \text{Corr}(X_1, X_2) \text{Var}(X_1)$$

and unless $\text{Corr}(X_1, X_2) > .5$, power is lost in a gain score design. Since the present reaction time data shows a level

of correlation between stimulus conditions of greater than .5, there is no loss of sensitivity in employing such difference scores.)

The difference measures were

$$W = TA + TU - UT - AT$$

$$L = XA + XU - UX - AX$$

$$A = TX + TX - UA - UA$$

Where TA refers to the stimulus array composed of groups of T's and groups of A's, with the target located in a group of T's. In contrast, if the target is located in a neutral stimulus group, then the neutral stimulus will occupy the first position of the letter pairing that designates the array condition. (e.g. UX has the target letter appearing in the U letter groups of the array.)

The first two equations that the composite difference scores are calculated from are composed by subtracting from the time taken to locate a target in emotionally relevant letter groups, the time taken to locate the target when it appears in the neutral stimulus groups of similarly composed arrays.

If there is an early allocation of attention resources to emotionally relevant parts of the perceptual field then we expect that the greater the level of emotionality the subject is operating under, the greater the difference times W (Win time), and L (Loss time). The other index A (Alerting time) is designed to be a measure of the extent that target detection is expedited by the emotional vs non emotional content of the display. If there is a general alerting (cf Posner, 1978) which is produced by emotionally relevant arrays, and this alerting hastens processing, then one

expects lower scores (more negative scores if the scores are below zero) on this index.

The target letter set contained 9 letters, and in generating the set of 120 arrays common to all subjects, the target letters (D, F, G, J, K, L, N, P, S) were assigned at random to each array, and were the same targets for every subject. After the subject made a response to a trial, the target letter in the array which was initially white in common with all letters in the array became the colour that the computer had chosen for that trial. The subjects then could tell whether they had predicted correctly, and from the group that the target letter was located in, the subjects could calculate the financial consequences of their decision.

The stimulus arrays were displayed on a Kaga (model KS14P colour monitor, and the experiment was controlled by an Apple II + microcomputer via the program listed in Appendix 4. Subject responses were timed via a voice activated relay consisting of a MTL F-96 Microphone and a Realistic CTR-40 tape recorder which fed into the computer cassette input slot. The time taken for the subject to respond was calculated from an assembly program written by the author, and modified from a program described by Price (1979). The timing accuracy was to the nearest millisecond.

Procedure

Subjects were randomly assigned to one of three conditions; significant stimuli-affective induction positive; significant stimuli-affective induction negative; insignificant stimuli. Significant stimuli conditions had

their payoffs contingent both on whether the right colour was chosen, and the letter group that the target stimulus was located in. (See Table (5-1)). Insignificant stimuli conditions had payoffs determined only by whether the target letter became the colour that the subject had chosen. The affect induction was attempted by the payment of non-contingent bonuses, or the extraction of non-contingent taxes during the course of the experiment¹. The assignment was done overtly at the beginning of the experiment by the toss of a coin to determine which group the subject would be in.

Having determined which group the subjects would be in, they were briefed on the nature of the game (see section on the gambling environment), and the kind of response that they were required to make. Subjects were told to name the target letter as fast as they could without making a mistake. To ensure that subjects understood the game and experimental task, and to reduce practice effects, a practice set of 24 stimulus arrays was presented. Subjects were informed that the gambles of the practice counted and the wins/losses of the practice would be counted.

A typical trial began with the subject being asked to type into the computer their choice of the two staking alternatives displayed on the screen. They then had to enter a number to indicate which of two colours they predicted would come up. At this point the subject could commence the part of the trial involving visual search by pressing the "Enter" button. All manual responses were performed using a hand held numeric keypad.

The initiation of a visual search trial was followed by a presentation of a colour patch on the screen for a

¹Bonus/Tax payments ranged between 10cents and 20cents, with one chance in five of occurring on any one trial.

duration of 500 msec. The colour displayed was that chosen by the subject for this trial, and the presentation was intended to act as a reminder of what the subject had bet on, and as a warning stimulus so that the subjects could prepare for their responses. Following the colour patch the screen went blank for a period of 5000 msec. (This time interval was required for drawing the stimulus on the non displayed screen.) The Treisman type stimulus array then appeared on the screen until the subject made a verbal response by naming the target letter; the letter which was not consistent with the group in which it appeared. The stimulus array was thereafter modified by the replacement of the target stimulus by the letter stimulus appropriate for that group, but in the colour chosen by the computer. The target stimulus was displayed on the border of the stimulus array at this stage in the colour that the subject had chosen. If the two coloured letters were of the same colour then the subject had chosen correctly. The modified stimulus array remained on the screen for 500 msec, thereafter a message of how much the subject had won/lost was displayed until such time as the subject pressed any key to commence a new trial sequence.

A pilot series had shown that subject error rates were very low, so during the experiment they were asked to report their own errors (if any). These errors were not correlated with a particular condition, and are so not analysed.

At the end of the experiment, subjects were asked to rate scales (E1 = HAPPINESS, E2 = DISTRESS, E3 = ANGER, E4 = ANXIETY, E5 = FEAR). The scale points ranged from 1 to indicate that the emotions described were not at all

present, to 7 which indicated that the emotions described were very much present at that point of time. At the end of the experiment which lasted approximately 50 minutes, subjects received their payment. Payments ranged from \$0.00 to \$7.90 depending on the subject's winnings.

Results

Initial analysis was performed to examine whether the groups differed in their mean levels of reported emotions. In recognition of the ordinal nature of the emotion scales (although it can be argued that there will be little deviation from an equal interval measure), nonparametric tests were performed on each of the scales. Kruskal-Wallis 1-way ANOVA's revealed that the three groups did not differ significantly on any of the five scales. As a consequence, all subsequent analyses were performed without reference to the original treatment groups. Given that there was no effect of gambling condition on the dependent emotion scales, it was assumed that the distribution of emotion scores in our subject sample approximated a normal distribution, and the joint emotion score and reaction time measure scores therefore can be represented as bivariate normal. Accordingly, correlations are reported, in preference to ANOVAs on groups obtained on the basis of a median split.

One tailed tests with $p < .05$ were used to assess the statistical significance of the results. All correlations opposite in sign to that predicted are therefore treated as statistically unreliable.

While the subjects completed five emotion scales the primary interest ^{was} _^ in the effect of the first two emotions

TABLE (5-3)

CORRELATIONS BETWEEN EMOTION SCALES AND ATTENTION
ALLOCATION AS MEASURED BY REACTION TIME DIFFERENCE MEASURES

Bonus and Tax Groups (n=20)					
<u>Attention Measure</u>	EM1	EM2	EM3	EM4	EM5
W	-.07	.51**	.41*	.31	.31
L	-.26	.14	.16	.14	.06
A	-.23	-.03	-.09	-.22	.23

Neutral Group (n=10)					
<u>Attention Measure</u>	EM1	EM2	EM3	EM4	EM5
W	.03	-.12	-.01	-.04	.27
L	.32	-.25	-.14	-.47	.16
A	.44	.18	.47	.48	.28

* $p < .05$, ** $p < .01$ (One-tailed test)

EM1 = Happiness, EM2 = Distress, EM3 = Anger, EM4 = Anxiety,
 EM5 = Fear.

TABLE (5-4) CORRELATIONS BETWEEN MONETARY OUTCOME INDEXES AND EMOTION SCALES

		EM1	EM2	EM3	EM4	EM5
Bonus/Tax	Final Amount	.20	-.45*	-.18	-.42*	-.06
Groups	Bon/Tax	-.02	-.36	-.31	-.48*	-.11
Neutral	Final Amount	.29	-.55	-.36	-.30	-.09
Group						

* $P < .05$ (One-tailed test)

TABLE (5-5)

CORRELATIONS BETWEEN MONETARY OUTCOME INDEXES AND
ATTENTION MEASURES

	<u>Bonus and Tax Groups</u>		<u>Neutral Group</u>
<u>Attention</u>	Final Amount	Bonus/Tax	Final Amount
<u>Measure</u>			
W	-.15	-.23	.52
L	-.31	-.28	.33
A	.23	.58**	.04

** $p < .01$ (Two-tailed test)

(happiness and distress) on the attention allocation measures. The correlations between the five emotion scales and the three measures of attention are reported in Table (5-3). The correlations between the W measure and the emotions of distress and anger were significant at the .01 and .05 levels respectively. No other correlations were significant.

Table (5-4) details the correlations between the monetary outcomes and the emotion scales. As would be expected, there are positive correlations between monetary outcome and positive emotion, while there are negative correlations between monetary outcome and negative emotions.

Table (5-5) shows the correlations between the monetary outcomes and the attention measures (W, L and A). There were no significant correlations for the measures of attention biasing (W and L). The correlation between the A measure, and the amount of noncontingent bonuses/taxes was significant.

Finally, there was a significant positive correlation between overall reaction time and the amount paid/taken in noncontingent bonuses/taxes. ($r = .5186$, $p < .01$; two tailed test). The correlation between the total amount that the subject ended with and overall reaction time was also significant ($r = .5284$, $p < .01$).

Discussion

The experiment was designed to test whether emotional states affect the early allocation of attention about the visual field. The pattern of correlations for the subjects who had 'friendly' and 'enemy' letters, was for the friendly letters, what would be expected if emotion biases attention towards mood congruent material. Specifically, the more

distressed and angry the subject, the slower they are to process those parts of the visual field that contain 'friendly' information. While the converse pattern was not seen for 'enemy' letters, this might have been because the game was enjoyable in itself so that no subjects really entered negative affect states which would have been attention biasing. Overall, the results of the correlation between emotional states, and the reaction time difference measures, are suggestive that emotion may be attention biasing, without providing a conclusive demonstration of this.

The correlations between a subject's monetary takings and the mood state on the emotion scales, were all in the predicted direction. It seems that the gambling environment is the ideal way to incorporate an emotion manipulation within an information processing experiment. Games have also been used by Isen et.al. (1978), and Frankenhauser (1976) as a means of inducing states of emotion. However, Isen and Frankenhauser did not employ emotion scales as independent checks of the success of their mood manipulations.

One set of correlations which were unexpected, were those between the bonuses and the A time, as well as the mean reaction time. The A time increased with the amount that was given (not taken away) from the subject. This indicates that the effect of winning (and presumably positive affect), was to reduce the advantage of affectively significant displays over neutral displays in terms of processing time. Such a result is the opposite of what would be expected from a simple account of emotion facilitating the processing of mood congruent material. The non significant correlation between the happiness scale and A also is in a

direction which indicated that there is a decline in the alerting by emotional stimuli with an increase in happiness.

The best explanation of the result might be that bonuses act to reduce tension and negative affect rather than enhancing positive affect, and consequently reduce the alerting by emotional stimuli. In contrast, high taxes are associated with considerable negative affect and so, we expect an emotion alerting facilitation for taxed subjects, and no facilitation for subjects who receive bonuses. Inspection of the mean scores on the A index for each of the subject condition groups confirms this. For subjects receiving bonuses, the mean A time was (-23 msec), for those receiving neither bonuses nor taxes, it was (-37 msec). For subjects in the taxation group, the difference was (-204 msec); subjects processed stimulus arrays composed of 'friends' and 'enemies' considerably faster than entirely neutral arrays. This indicated that relatively intense emotion might result in more processing resource availability to any stimulus with emotionally relevant elements.

Another surprising result was the positive correlation between monetary outcomes and overall reaction times. The time taken to perform information processing tasks is often used as a validator of affect induction procedures (e.g. Velten, 1968). Typically it is found that with increased levels of negative affect, processing time increases. The reverse finding in the case of the present experiment might reflect the fact that the affect induced in the present gambling experiment is not akin to that associated with ongoing mood states. Instead, the patterns of affect induced in gambling experiments are likely to be momentary.

Thus, rather than because of emotion, the reaction time increase with gambling success might be because the accumulated arousal associated with unsuccessful gambling produces an improvement in information transfer in losing subjects (cf Humpheys & Revelle, 1984).

The results of this experiment indicate to some extent the plausibility of the suggestion of Klinger (1982) that one of the influences of emotion is in the sequencing and allocation of resources to current concerns. Klinger suggests that "...attentional mechanisms are themselves steered in part by emotional response, which in turn is anchored in goal striving." (p.139-140). The present experiment seems to indicate that the attentional mechanisms are flexible enough to operate on stimuli that have very little intrinsic evaluative significance (viz. the letters in the current experiment).

The two reservations to claiming a certain demonstration of emotion on information processing are firstly the possibility of a Type I error, and secondly that it may reflect strategies unrelated to emotion. The former possibility cannot be ruled out considering the large number of correlations reported in Table (5-3). However, there were only 4 specifically predicted correlations and the largest significant correlation was amongst these. The second possible reservation, of a conscious strategy difference between happy and unhappy subjects seems unlikely, since the information in a stimulus array was insufficient to provide complete outcome information prior to the subject's response. The next experiment eliminates all possible strategy advantage by employing affectively significant stimuli that

have no connection with gamble outcome.

Experiment II

The second experiment was designed to be a more straightforward demonstration of the influence of affect on attention. As well, it broadened the range of affect states that were examined to include the affect associated with the outcome of a single trial.

The experiment used schematic faces as the affectively relevant stimuli, but the faces themselves were irrelevant to the gamble outcome, and the task required of the subject. The subject had to name the odd-hat-out of the hats which were on the heads of the schematic faces. The hats also gave no indication of the outcome of the gamble, so the display which related to the task, contained no information of relevance to the gamble.

The prediction for the second experiment was that when the target hat was on the head of a mood congruent face, it would be detected more rapidly than when it was on a mood incongruent, or neutral face. This result would be unambiguous evidence for the consequence of emotion on attention, as there were no incentives for gamble related strategies in the information processing task.

The second task differed from the first also in the time at which subjects were informed of the outcome of a gamble. In the second task, the winning colour appeared at the same time as the hat-wearing schematic faces. Thus, subjects had immediate knowledge of success or failure (unlike the first experiment when the outcome was signalled after the subject's task response). It was hoped that this procedure

would mean that there were two conditions of instantaneous affect; one associated with winning trials; one associated with losing trials. In this way, the second experiment introduced a within subject factor of momentary affect state. The experiment could then be analysed to show changes in attention allocation within subjects dependent upon momentary affect states. Such a demonstration would be an important demonstration of the influence of affect on attention.

Throughout the second experiment, it was assumed that the conjunction of two sets of 'features' (hats and faces), meant that there was only serial processing of individual elements of the display. However, as the experiments of Treisman and Gelade (1980) indicate, segregation of the perceptual field occurs in parallel. The present experiment looks at whether parallel segregation by affectively significant features into regions of interest, can reduce the serial search time.

Method

Subjects: Subjects were eighteen students of the University of Canterbury, recruited at the same time, and under the same conditions as those subjects in experiment I.

Stimulus Materials and Design

The experimental stimulus consisted of a display composed of eight head shapes circling a central square colour patch, (see Figure (5-2)). The visual angle subtended by the total array was 8° horizontally and 8° vertically, and the head shapes each subtended a visual angle of 2° horizontally and 2° vertically. Each head shape wore a hat,

and often contained internal lines which in some cases created schematic faces. The kinds of hat which would appear on the faces were clown hats, bowler hats, top hats, and crowns. The hats were colour filled, and there was an even chance that the hat colour would match that of the central colour patch. The four kinds of facial configurations that could appear were a blank face, a face with two dots on the diagonal separated by a diagonal line, a happy face, an unhappy or distressed face.

All stimuli (which were combinations of facial configurations and their headwear), were made by combining shape tables for faces with shape tables for hats. The tables were created using the Versa Writer package (see Note 2 for details).

There were a total of twelve kinds of stimulus conditions of interest. Any display would contain two groups of four identical facial elements. As well, all faces bar one in the display would wear an identical hat. A display had seven heads with identical hats. One stimulus would have a different hat, and that stimulus would be the target stimulus for the experiment. The twelve different stimulus conditions are illustrated in Table (5-6).

As in the first experiment there were a total of 120 stimulus displays during the course of the experiment, and there were two presentations of each display type shuffled within each sequence of 24 trials. All subjects had the same set of face stimuli and hat stimuli presented during the experiment, but it was not predetermined whether the colour of the hats would match that of the central colour patch. (The colour of the central colour patch indicated

TABLE (5-6)

TABLE OF STIMULUS ARRAY CONDITIONS FOR EXPERIMENT II
SHOWING AFFECT LEVELS

<u>Target Faces</u>	<u>Distractor Faces</u>			
	B	N	H	S
B (Blank)		(00)	(0+)	(0-)
N (Nonsense)	(00)		(0+)	(0-)
H (Happy)	(+0)	(+0)		(+-)
S (Sad)	(-0)	(-0)	(-+)	

(+ = affectively positive face; - = affectively negative face; 0 = affectively neutral face. The first symbol inside the brackets refers to the face type that wears the target hat, and the second symbol refers to the distractor face type)

what colour the subject chose, the colour of the hats circling the colour patch was the colour that the computer chose).

Reaction time difference measures of attention allocation were calculated from the following formulae.

$$H = HN + HB - NH - BH \quad (\text{Happy bias})$$

$$S = SN + SB - NS - BS \quad (\text{Sad bias})$$

$$A = HS + SH - NB - BN \quad (\text{Alerting})$$

Where the first letter in a letter pair refers to the letter that designates the type of face that the target hat is on, and the second letter refers to the other kind of face in the display concerned. The rationale behind these difference measures is parallel to the rationale given in the earlier experiment. If, in some way emotion induces an attention bias towards information consistent with emotional states, that should show up as a correlation between emotional intensity and the reaction time difference measures.

The target stimulus was located randomly in positions one to eight in the display. The orientation of the split between the four face configuration 1 and the four face configuration 2 stimuli was also at random.

All displays were presented on a Kaga Model KS14P colour monitor, and the experiment was controlled by an Apple II + microcomputer via a program listed in Appendix 4. Again, the reaction time was recorded using the assembly language routine used in experiment I.

Procedure

Subjects were assigned to one of two conditions; bonuses or taxes. The taxes and bonuses which the subject received

during the experiment, were not contingent upon subject behaviour. The taxes and bonuses were set to range from 10 cents to 30 cents, with one chance in five of occurring in any one trial.

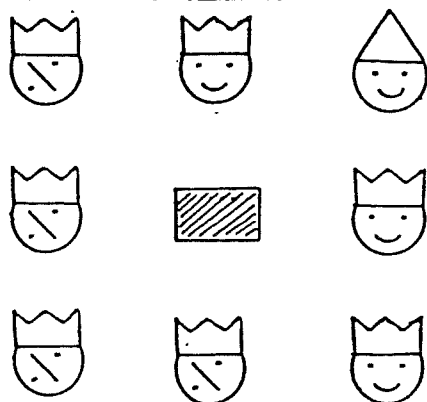
The subjects were initially briefed on the nature of the game, and the task responses that they were required to make. Subjects were told to name the type of hat that differed from the hat worn by all other head stimuli. They were asked to do this as quickly as possible without making a mistake. A practice set of 24 trials was then completed.

The decisions about stakes and the colour to bet on were made in the same way as was described in experiment I. After these decisions had been made, the subject could initiate the visual search trial. A colour patch in the colour that the subject had chosen was then displayed for 500 msec, followed by a period of 2000 msec during which the screen was blank. After this a display composed of 8 head stimuli and a colour patch appeared. The colour patch was the central element in the 3 x 3 array. (See Fig (5-2).) If its colour matched the colour of the hats appearing on the heads, the subject won, if it did not, the subject lost. The subject named the hat that was the odd one out, and thereby set off the voice activated relay and a reaction time was obtained. After naming, the stimulus was replaced by a message of how much the subject had won or lost which remained on the screen until the subject pressed a key to commence a new trial. Again, as in the previous experiment subjects were required to report their own errors. Such errors were extremely rare.

At the end of the experiment, the subjects completed

the five emotion rating scales which were outlined for experiment I. The subjects then received their payments. Final payments ranged from \$0 to \$11, with the average payment being \$5.02.

Figure (5-2) Stimulus for Experiment II



An example stimulus array with a happy target face, nonsense distractor face and the target hat is a clown hat.

Results

Initial analysis of the emotion scales revealed that there were no significant differences between the bonus and tax groups on any of the emotion scales. The mean levels of the groups from experiments I & II are reported in Table (5-7). As in experiment I, correlations were performed between the five emotion scales and the three difference time measures. These correlations are reported in Table (5-8). There were no significant correlations.

The absence of significant correlations between the subjects enduring mood state and the processing of emotionally significant stimuli as measured by the three reaction time difference measures, means that an analysis of the second experiment has not revealed the same pattern of effects that were obtained with the more artificial letter stimuli

TABLE (5-7)

MEAN EMOTION SCALE SCORES FOR EXPERIMENTS I & II

Experiment I					
<u>Group</u>	EM1	EM2	EM3	EM4	EM5
Bonus	3.6	1.6	1.9	1.8	1.2
Tax	3.7	3.1	2.1	3.0	1.9
Neutral	4.0	2.8	2.1	3.1	1.7

Experiment II					
<u>Group</u>	EM1	EM2	EM3	EM4	EM5
Bonus	3.6	2.1	1.6	2.6	1.2
Tax	2.8	2.1	2.1	2.4	1.0

(EM1 = Happy, EM2 = Distress, EM3 = Anger, EM4 = Anxiety,
EM5 = Fear)

TABLE (5-8)

INTERCORRELATIONS BETWEEN EMOTION SCALES AND ATTENTION
ALLOCATION MEASURES PROVIDED BY REACTION TIME DIFFERENCE
SCALES. (EXP 2.)

Attention

Measures	EM1	EM2	EM3	EM4	EM5
H	-.327	.089	-.086	-.326	-.249
S	.099	-.071	.102	.0153	.062
A	-.021	.215	.221	.113	.089

of the first experiment. However, one very important way in which the second experiment differs from the first experiment, is that the stimulus display contains unambiguous outcome information which appears simultaneously with the task relevant information. Thus, the display contains what is likely to be a powerful momentary affect modulator. The data were analysed to contrast attention allocation when a momentary positive affect was generated, with attention allocation when momentary negative affect was generated. (Winning and losing generates momentary positive affect and momentary negative affect respectively).

The reaction times for the two momentary affects are detailed in Table (5-9), and (5-10). Table (5-11) details the differences in reaction times for each of the stimulus conditions. Analysis of variance of the reaction time data in a repeated measures design encompassing all eighteen subjects, with factors of outcome (O), target stimulus type (T) distractor stimulus type (D) was done using the BMDP4V program. The design had four missing cells for the combinations of stimulus targets and distractors that were identical. Table (5-12) details the significant effects, and their interactions. The listing of separate interactions OT!(OD) and OD!(OT) reflects the fact that this design is not completely crossed, and effects T, O, OT, OD, are estimates based on weighted combinations of cell means, and are thus not orthogonal. A series of repeated measures t-tests were performed to investigate which stimulus types differed significantly between winning and losing trials. The significant t-tests for 17 degrees of freedom are detailed in Table (5-11).

TABLE (5-9)

RAW REACTION TIMES (IN MSEC) FOR TARGET AND DISTRACTOR COMBINATIONS, ON WINNING TRIALS *









		Distractor Stimuli				
						
Target Stimuli			1495	1486	1425	1487
		1560		1450	1550	1520
		1559	1546		1480	1528
		1491	1451	1474		1472
		1536	1697	1470	1485	1497

TABLE (5-10)

RAW REACTION TIMES (IN MSEC) FOR TARGET AND DISTRACTOR COMBINATIONS, ON LOSING TRIALS *

















		Distractor Stimuli				
						
Target Stimuli			1628	1632	1548	1602
		1722		1560	1544	1609
		1665	1538		1515	1573
		1693	1499	1561		1584
		1693	1555	1584	1536	1592

TABLE (5-11)

DIFFERENCES IN REACTION TIME (IN MSEC) FOR TARGET AND
DISTRACTOR COMBINATIONS BETWEEN WINNING AND LOSING TRIALS *

		Distractor Stimuli			
					
Target Stimuli			-133	-146+	-123
		-162+		-110	+6
		-106	+8		-35
		-202+	-47	-87	

* In Tables 7, 8 and 9, where data is missing, it has been replaced by the value from the other half table for the purposes of calculating the mean.

(+ $p < .05$ two-tailed test)

TABLE (5-12)

TABLE OF TESTS OF MAIN EFFECTS AND INTERACTIONS

<u>EFFECT</u>	SS	DF	MS	F	P
O (Outcome)	.3677	1	.3677	10.9	.01
T (Target)	.0424	3	.0141	1.03	.39
D (Distractor)	.2430	3	.0810	5.53	.00
O x T	.0683	3	.0228	1.70	.18
O x D	.1118	3	.0373	2.33	.09
T ! D	.0709	3	.0236	2.06	.12
D ! T	.2715	3	.0905	7.32	.00
O x T ! O x D*	.0982	3	.0327	2.50	.07
O x D ! O x T	.1418	3	.0473	3.01	.04

(! = removing effects following the symbol)

* Note, by an alternative statistic (TSQ), this effect is significant (TSQ = 15.8, F = 4.52, p .025)
 (TSQ \equiv Hotellings T-squared statistic.)

There is a more comprehensive way of looking at Table (5-11). If we consider winning trials, then

$$W(S(w, \sim w)) < W(S(\sim w, w)) \quad (i)$$

Where the capital W outside the bracket indicates the outcome. The S(X1, X2) indicates the target-distractor combination: X1 is the target stimulus type (in this case win compatible), and X2 is the distractor stimulus type (in this case not win compatible).

In losing trials we expect

$$L(S(\sim w, w)) < L(S(w, \sim w)) \quad (ii)$$

where L indicates a losing outcome.

Unfortunately, we cannot use the comparisons suggested by (i) and (ii) because the conditions were not balanced for target position. However, a reasonably valid comparison can be made through the fact that

$$W(S(w, \sim w)) - L(S(w, \sim w)) < W(S(\sim w, w)) - L(S(\sim w, w)) \quad (iii)$$

The left hand side of the above inequality represents an entry from Table (5-11), that has a happy stimulus in the target position, while the righthand side represents the same target-distractor pair, only with the winning stimulus as distractor.

By similar reasoning to that above, it can be established that

$$W(S(\sim 1, 1)) - L(S(\sim 1, 1)) < W(S(1, \sim 1)) - L(S(1, \sim 1)) \quad (iv)$$

In the case of both (iii) and (iv), position effects (at least simple position effects), have been effectively eliminated as they are subtracted out on both sides of the inequality.

TABLE (5-13)

INTERCORRELATIONS BETWEEN MONETARY OUTCOME INDEXES
AND EMOTION SCALES IN EXP. 2.

Groups 1 & 2 n=18	EM1	EM2	EM3	EM4	EM5
Finishing					
Amount	.249	-.279	-.077	-.056	.241
Bon/Taxes	.272	-.008	-.247	.043	.355

TABLE (5-14)

INTERCORRELATIONS BETWEEN MONETARY OUTCOME INDEXES
AND MEAN REACTION TIME

	Finishing Amount	Bon/Taxes
Mean	-.028	-.068

The inequalities (iii) and (iv) give rise to five predictions for Table (5-11). Designating table entries by $A(i,j)$ where i is the row index and j the column index, the following inequalities are predicted:

$$A(1,4) < A(4,1) \quad (d = -79)$$

$$A(2,4) < A(4,2) \quad (d = -53)$$

$$A(3,4) < A(4,3) \quad (d = -47)$$

$$A(1,3) > A(3,1) \quad (d = 40)$$

$$A(2,3) > A(3,2) \quad (d = 118)$$

The bracketed figures to the right of the inequalities are the differences between the two table entries. As can be seen, they are all in the predicted direction.

In the absence of estimates of the three way interactions between outcome, target and distractor, (because of missing cells in the ANOVA), the prediction set above provides a test of the attention allocation hypothesis. The probability of all five predicted inequalities being in the right direction is $(.5)^5 = .031$.

Finally, Tables (5-13) and (5-14) detail the results of correlating the monetary outcomes with the emotion scales, and the mean reaction time. Although they do not bear critically on the analysis (especially not that for momentary affect states), they are included for completeness. (Comparisons between the data of the first experiment and that of the present experiment can be made with this data.)

Discussion

The most important finding to come out of this experiment, was the clear evidence for the effect of momentary affect states on the allocation of attention in the visual field.

The experiment contained stimulus conditions that were equivalent except for the reversal of target and distractor stimuli. The particular prediction set which was derived from the principle that 'affect state congruent information is processed first', was totally upheld. It is this principle which may underlie the significant interaction between outcome and target which because of the confounding between target and distractor is not readily interpretable. The prediction set derived as it is from the apriori principle of attention allocation policy stated above is a very specific test of the effect of emotion on attention allocation. As well, the result highlights a phenomenon not considered in many of the experiments in the field of emotion; that emotional states are often fleeting stimulus elicited events that show considerable fluctuations between the times that subjects fill in emotion rating scales. (cf. Nisbett & Wilson, 1977).

In some ways, the only parallel to these results is to be found in the perceptual defense - perceptual vigilance literature discussed in chapter three. The demonstrations of such experiments (discussed in Dixon, 1981), of some form of early non conscious processing of stimuli, leading to defence or vigilance, is much akin to what has occurred in this experiment.

The results are quite remarkable in the light of what the subjects revealed at debriefing. At this point, the experimenter carefully explained the rationale of the experiment, including the role of the various face stimuli. Almost all subjects commented on this information to the effect that during the experiment they had been oblivious

to all aspects of the heads. They claimed that all they were aware of was the hats, and the faces never were noticed. Several subjects expressed disbelief that there had been any faces beneath the hats at all.

If these subject reports are taken as reliable (and subjects had no motives to lie about not noticing the faces), then it provides phenomenological evidence that the effects obtained are because of preconscious processing of the affective aspects of the stimulus display. That of course is what has been hypothesised all along, but it is remarkable that the effects obtained here have arisen without the attention biasing aspect of the display even being noted by the subjects. Thus, the results are compatible with the suggestion of Zajonc (1980) that an emotional analysis precedes cognition. However, they go further in that they demonstrate that the early emotional analysis is utilised in emotion biased attention allocation policies.

In terms of which conditions showed the largest differences in reaction time between winning and losing trials, there were three that were found statistically significant. There was considerable advantage to the stimulus array with smiling targets and blank distractors in the winning outcome condition. There was also a considerable advantage to the stimulus array with blank head and unhappy distractor stimuli for winning conditions. The third significant difference was for a 'nonsense face' target with a blank distractor head. The first two differences are predicted by the emotion congruent attention allocation policy hypothesis.

Perhaps the best indicator of the attention biasing is

to be found in the conditions that did not have slower reaction times in losing trials than in winning trials. This was the case firstly for the unhappy face target with nonsense face distractor, and secondly for the nonsense face target and a happy distractor. In the former case, the target was compatible with negative affect, and in the latter case, the distractor was incompatible with negative affect. The results are both explained by the negative affect biasing attention towards affect compatible regions in the visual field, and away from affect incompatible regions of the visual field. Thus, in the two cases discussed, when the subjects lost, the negative affect produced, would have resulted in serial processing beginning with the type of face that had the odd hat out above it.

The second experiment did not confirm the findings of the earlier experiment of correlations between emotional states and the reaction time difference measures. This might be attributable to the momentary affect state being the overriding determiner of reaction time variation in the current experiment. Certainly, the significant results for momentary affect and the fact that immediate feedback occurred after the visual scanning task in the first experiment are compatible with this interpretation.

The experiment also failed to replicate the correlations between finishing amounts and emotion scale scores found in the earlier experiment. The results were in the same direction as found earlier with higher winnings associated with more happiness and less negative affect but they were not significant. There does not seem good cause to doubt the usefulness of the gambling environment because of these

results.

One other finding from experiment I which was not replicated in the present experiment was the correlation between the monetary outcome measures, and the mean reaction time. The earlier result was surprising since it indicated slower times for happier subjects. In the light of the low correlations found in the present experiment, the earlier correlations may be attributed to Type I errors, or strategy effects. The latter of these possibilities suggests a slower search for outcome relevant information in subjects who were winning. The same strategy would not be possible in experiment II, because the immediately available outcome information was contained in the array colour which might be assumed to be an immediately available feature code.

One significant result that deserves further investigation, is that of the longer time required to find the target on losing trials. Such a result could arise because of a longer time spent checking the gamble outcome in the case of losing trials; it could be an artifact of a difference in colour between the central colour patch and the surrounding stimuli; or it could be the effect of a momentary negative affect on information processing. Further experiments are required to determine the cause of the phenomenon.

Conclusion

The two experiments reported in this chapter have provided evidence that emotion has an influence upon attention allocation in the visual field. Experiment I provided evidence that the subjects enduring emotional states induced by their overall success in gambling has consequences for

attention allocation. Experiment II produced strong evidence that momentary emotional states that coincide with success or failure on individual gambles biases attention towards affect congruent regions.

The results from both experiments can be interpreted as demonstrating that there is an early analysis of information into its emotional relevance, and that subsequent processing priority is determined by this emotional analysis. This suggestion is quite congruent with the position of Zajonc (1980) that affect may precede cognition. The emotional analysis may occur in parallel and on more data-limited input than a cognitive analysis. After the emotional analysis, the serial cognitive analysis can proceed with well defined 'regions of interest'. These regions of interest are most likely to be encoded into working memory earliest, and thus their information will be first available to action schemata and response processes.

The interpretation above fits in well with the argument of Klinger (1982) that the emotion subsystem must at some stage of its ontogenesis, have assumed some functions related to directing the substance (information) processing goals of the organism. It can also explain why there seems to be no necessary linkage between eye position and focus of attention (Posner, Davidson & Snyder, 1980; Posner, 1982). If attention allocation is contingent upon an early analysis by an emotional processing system, then it is not expected to be foveally located. What is expected is that once a data-limited analysis has been completed, and attention allocation is determined, ocular focus will also shift to the region of interest. Posner (1982) reports that covert

attention precedes eye movement by 150 msec.

The evidence connecting affect state and attention allocation obtained here is an important confirmation of the linkage suggested in functional theories such as Klinger's. There do not seem to be any previous attempts to provide information processing measurements of the linkage. Thus, these experiments have provided important confirmation of evolutionarily derived theory, and a means of demonstrating and measuring an important microprocess of emotion.

Chapter six:

An account of the emotion system: a final look at the relationship between emotion and cognition.

This chapter will attempt to provide a model for some of the phenomena associated with emotion. It will not narrowly focus on the results of the previous three experiments, but it will consider some of the way in which emotion appears to operate in everyday life. The data base taken both from the laboratory and the world is construed within a framework that attempts to relate the functioning of the emotion system to the operation of the cognitive system. The need to consider a particular system in the context of its interactions with other systems is advocated by Royce and Diamond (1980). It is also reflective of the fact that as well as considering the designed function of systems, it is also necessary to consider the way in which systems are utilised by agents.

A Speculation on an Evolutionary Pathway

Patry (1983) has suggested that evolutionary theory is often unjustifiably used by psychologists. He suggests that the use of evolutionary theory in psychology should be restricted to several fairly narrow scientific contexts, including amongst them the context of discovery. That is, evolutionary theory can be used to help find new ideas on how human beings could function. These ideas however require testing and justification before they can acquire a status beyond that of 'just ideas'. In accord with this use of evolutionary theory, a speculative sequence for the development of emotion system functioning is put forward, and

its consequences for patterns of information processing and action within the species *homo sapiens*, is considered.

It is proposed that any organism has the task of finding substances and incorporating substances required in organism functioning. Thus, common to all motile species are stimulus-response tendencies that have selective advantage for the species. In as much as it is the goal of the organism to follow an optimal (ingestive) strategy, it is necessary for the organism to detect, and evaluate objects. Further, where an object cannot be readily evaluated, or where it must be operated on by the organism, orientation towards that object is a necessity. Thus, it is going to be advantageous for organisms to be able to prime behavioural sequences appropriate to perceptual categories. Accordingly there is a fundamental linkage between perception and action in organisms that is developed early in the evolutionary time-scale (cf Klinger, 1982).

The early linkage of a perception-action package then provides the elements for the creation of a signalling system whereby members of a species can be alerted to significant aspects of the environment by the signalling of one of their members most proximate to the region or object of significance. The evolutionary pathway postulated here suggests that there is a selective advantage for individual organisms that develop clear signalling patterns, and an early acquisition of encoding skills that allow the rapid reaction to these signals. Once a species has acquired a visually based signal system, it will bias selection fitness in a way that makes those individuals which are most responsive to valid signalling and which are most likely to

be proximate to signal sources, have higher survival rates. The consequence of this is that as species evolve more visual signalling capabilities, they also become more spatially compact in the distribution of individuals. In other words as we trace the development of visual (and auditory) signalling systems in a species, we expect to find the contemporaneous development of some form of social structure.

As the development of behaviour specialised for signalling occurs, at the same time as it provides a selective advantage to those individuals more disposed to social living, there is an increased advantage for associating affective responses (in particular signalling) with a broader range of situational inputs. Such an advantage could result in changes in several ways including -

- a) A broadening of affect elicitors to include situations which, while they do not actually include emotionally significant objects (such as predators or prey), are precursors of situations containing these elements.
- b) A tendency to replace highly specific, innate, object related emotion elicitors, with classes of learned emotion elicitors.
- c) Emotions being conditional more upon information characteristics than upon information content. For instance the rate of density of neural stimulation (as suggested by Tomkins (1962; 1980)), rather than the specific object involved might be the necessary encoding for affect instigation.
- d) A widening of the range of emotions displayed to the extent that there is an available repertoire to encoding all

situations encountered by the organism. (In terms of the functional language of Plutchik (1980), an increase of the number of functions to include functions such as reintegration which is advantageous for a social animal).

This broadening of the range of affect elicitors will be dependent on the development of a higher level of cognitive functioning, and its connection with emotional processes. The cognitive expansion will be advantageous because it will result in more sophisticated categories that allow a fine discrimination between objects that merit affective response, and those similar objects to which affective responses would be disadvantageous. With the aid of cognitive analysis to such a fine level of discrimination, the costs of broadening the application of emotional processes will not be too high. Rather than an increase in the incidence of emotion that evolution without an element of cognitive control would result in, evolution with cognitive ^{control} _^ simply increases the potential evocation of emotion.

The possible evolutionary path towards final cognitive-emotion interactions is difficult to specify because of the potential complexity of such interactions. However, several clear trends evident in the forms of human emotion-cognition interactions can be listed:

(1) In what Tomkins (1980) refers to as the 'unmodulated, ungraded innate response', where there is minimal deviation from prototypical patterns of response because of cognitive input, attention allocation to the objects of affect will be enhanced.

(2) In the modulated innate response, where there would appear to be more cognitive control, the initiation of more

primal action patterns will be inhibited. Substituted will be one of a set of global encodings about causation and the associated reequilibration conditions. The substitution of such a global encoding, henceforth referred to as a PER (prototypical emotional relations), is a powerful motivator and guide to the solution of the situational danger.

(3) As well as the emergence of PER type control schema, there is an increase in the use of monitoring-diagnostic schema which reduce the extent of feeling if events are going to plan.

(4) The extent to which affect producing conditions have influence on the qualitative processing of other situations will increase. Thus, the effect of the kind of weather conditions presently enjoyed can have an influence upon other judgements (Schwarz and Clore, 1983).

This increase in the pervasiveness of affect is easy to understand if the direction that evolutionary movement takes is seen as away from fixed patterns of behaviour in order to effect survival functions, and towards non predictable behavioural sequences that achieve survival functions via intermediate goals. The effect of suppression of fixed action patterns by intermediate goals, is to enable the individual organism to be operating on multiple matters of concern at any point in time. This is possible by relaxing the strong binding between emotions and their action patterns, and replacing them with weak bindings between emotions and goal-action sequences. The advantages for the organism of this substitution are

(a) The functional goals that lie behind affect can be worked towards prior to the situation to which

the action patterns are adapted to. It is obviously advantageous to start avoidance planning prior to the immediacy of the danger.

(b) The possibility of operating on multiple matters of concern, is advantageous in terms of the economic use of multiple environments. For instance, the loss of a companion in the heat of the battle provides stimulus conditions for both rage, and sadness. However, sadness can be reserved until affiliation conditions are more optimal (e.g. the military funeral). Thus, the danger of being overcome by sadness is reduced by setting up an intermediate, environment-specific, comfort goal.

(c) A loose binding between emotions and goal-action sequences, will permit the fundamental relationship established in the information processing that caused the emotional experience, to bring about immediate changes in the priorities of a whole set of concerns. The activation in the goal effecting schema brought about by the PER, in not remaining specific, results in a set of behavioural imperatives that do not reach cessation until a satisfactory level of coping is achieved for all related concerns.

An example of how this might be advantageous to the individual organism, is the way in which the evoking of a PER for fear by say the presence of a predator, might also at a later point produce an increased likelihood of fear of floods. Such a cycling through safety related concerns, and the adequacy for their goal-action sequences, will favour

the location of a more than 'satisficingly' safe environment when escape occurs.

(5) The development of an attributional search process that follows affect onset. The fact that affect is no longer tied to obvious environmental relations, but can be the consequence of the success/failure of a series of goal-action sequences, means that complicated ways of deriving the 'cause' of an emotion must be allowed. Most probably the particular attribution heuristics are learned, but the possibility of their development is a consequence of an evolutionary parsing of the possible affect-cognition relations.

The emotion-cognition interactions suggested by the evolutionary pathway outlined also carry certain implications for the culture preserved ways in which emotions are employed. There are obvious 'content based' distinctions which condition emotional and cognitive functioning for a particular cultural group. For instance, aesthetic preferences are most probably culture relative (Mandler (1982)), and are partially transmitted by emotional contagion processes occurring between child and significant care givers. It is highly functional for care givers to transmit knowledge intergenerationally with the help of affective encodings provided by the contagion process. Transmitting information in this way, gives a receiver a readily useable set of categories, by which knowledge can be structured and action tendencies established. It would be considerably more traumatic and dangerous for the individual to establish his/her own affective structure on the transmitted information.

Of course, the transmission of an evaluated knowledge base is not totally fixed, and the individual's experiences can modify the value associated with information. One example of where the slow process of value modification has occurred is in the area of sexual values: effective means of contraception now mean that taboos on sexuality outside of contractual arrangements are slowly being relaxed. A new positive value to knowledge about contraception and sexual functioning has replaced the negative value previously associated with such knowledge.

Emotion and Cognitive Skills

As well as the species common, biologically evolved links between emotions and information processing systems suggested above, there is also the consequent characteristics of the acquired cognitive structure that also reflects the importance of emotion in knowledge acquisition. Several theorists (e.g. Mehrabian & Russell 1974; Heise 1979) have taken advantage of the pervasiveness of the semantic differential factors (Osgood, Suci & Tannenbaum 1957) and have equated them with affective dimensions, and used them to form the basis of a means of predicting behaviour in various situations. The success of such approaches suggests that an evaluation process that might result in affect is an integral part of all normal information processing, and that it might be an important determinant of just what is learnt.

An empirical relationship between affect and learning has been well demonstrated in several studies. For instance, Brown & Kulik (1977) have shown the phenomena of flashbulb

memories, Loftus and Burns (1982), have shown that mental shock can lead to retrograde amnesia, and various studies by Bower and his colleagues (e.g. Bower, 1981) have shown the influence of congruent affect at encoding on the recall of to-be-remembered material. What is missing, is an understanding of the way in which the emotion system plays a part in normal as well as exceptional learning. The existing results do not explain how the emotional dimensions of the semantic differential can be a ubiquitous presence across various semantic domains. Here, we try to look at the influence of emotion on normal learning processes by analysing where it might be accommodated within the theory of the acquisition of cognitive skills advanced by Anderson (1983) and Anderson, Kline and Beasley (1980). It will be argued that the pervasive link between emotion and meaning as demonstrated by the semantic differential, is because the fundamental direction of cognitive skill acquisition is determined by emotional plan heuristics, and that the development of cognitive skills requires encodings (meanings) that can be characterised in terms of the relevance of new information to these heuristics.

The ACT Model of Cognitive Skills

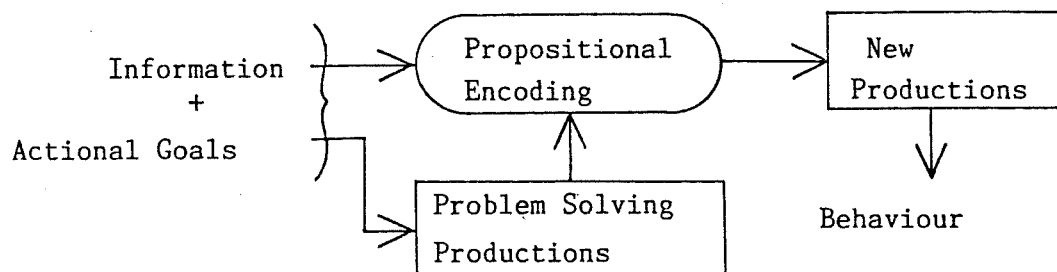
The theory developed by Anderson sees the development of cognitive skills arising in three stages. The initial stage termed the declarative stage, is one where knowledge in a new domain starts out in a declarative form, and is used to generate productions according to whether it is called upon by general problem solving procedures. The second stage in Anderson's theory of cognitive skills is

that of knowledge compilation, where the system develops productions that apply directly without the need of prior interpretation. The final stage of the theory, is that of procedural learning, where the sets of available production rules are 'tuned' to the requisite level of specificity and strength with respect to particular environments. The full sequence of learning stages is outlined in Figure (6-1).

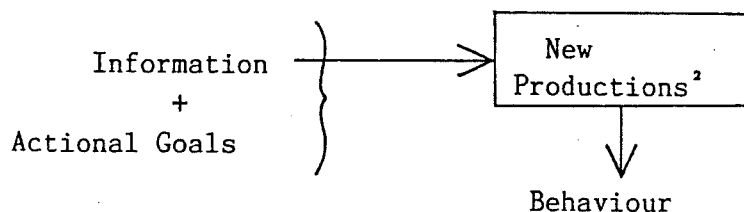
In terms of emotion theory, the analysis of complex learning suggested by Anderson is important because in acknowledging the importance of a heirarchical goal structure involved in complex learning, the theory makes a provision for an important link between emotion theory and cognitive learning theory. There is quite a degree of agreement between emotion theorists that some kind of goal structure is involved in human affect. For instance, Bower and Cohen (1982), suggest that the information processor has a class of events called "goal events", and that these goal events play important parts in emotional interpretation of production rules. Bower and Cohen note that "The importance of goals is that they direct processing in the system." (p.312). Thus, the production system model of emotion that they employ, has much in common with the production system model of learning of Anderson and his colleagues. Another theorist that finds a close tie between emotion and goal structures is Pervin (1983), although his formulation is more in terms of traditional learning theory.

FIGURE (6-1)

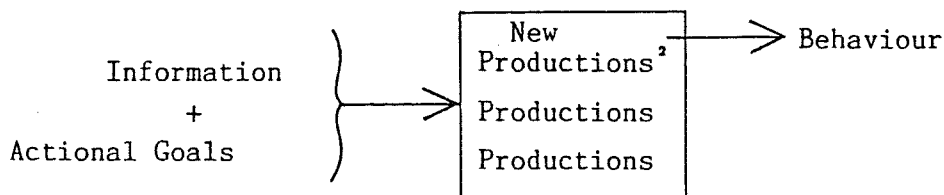
STAGES OF LEARNING FOR THE ACT PRODUCTION SYSTEM.

(1) Declarative Stage.

(Note: New information or 'facts' are given a propositional encoding prior to being used by the general problem-solving productions.)

(2) Compilation Stage.

(Note: New Productions → New Productions² . The latter productions do not require the actions of general problem-solving productions prior to use.)

(3) Procedural Learning Stage.

(Generalisation and discrimination increase or decrease the application of productions. Commonly used productions are strengthened, and are more likely to influence behaviour.)

Questions about the Influence of Cognition in the
Development of Affect

The linking together of emotion and cognitive processes is an important theoretical endeavour, not just because of the virtues of scientific parsimony, but also because of the light that can be thrown upon the nature of the ontogenesis of emotion. Researchers from Darwin (1877) have studied the ontogenesis of emotion, and there is good evidence for a developmental sequence in the appearance of the primary emotions. Izard (1980, 1978) has given an account of such a developmental sequence. It is important that the cognitive prerequisites for an emotion to appear in the neonate be studied, both for its clinical implications, and also the light that it can throw on emotion theory. If as Izard has suggested at the neurological level "...a fundamental emotion is defined as a particular, innately programmed pattern of electrochemical activity in the nervous system." (p.167, 1980), then the way in which the cognitive system might be involved in maintenance of the pattern of activity must be investigated.

Another question that should be investigated is whether the maturational sequence of the emotions is innately programmed, or is instead a consequence of the emergence of a particular set of cognitive skills that enable the processing and action tendencies associated with emotions. That is, are there learning invariants that precede the formation of affective structures, or is it merely biological events that are necessary for the development of adult emotion? Some evidence discussed by Jones and Smith (1980) suggests

that there are similarities between animals with hippocampal damage, and animals reared in social isolation. They point out that these results can be interpreted as a consequence of a motivation related memory system impairment. If this is the case, then it would appear that the environment and some form of learning, play an important part in the development of appropriate emotion in the rat.

There is certainly no doubt that an environment that is impoverished in terms of social stimulation, has a negative influence on emotional development. The work of Harlow (e.g. Harlow, H. & Harlow, M.H., 1966), of Bowlby (1969), and the studies of institutionalised children (e.g. Spitz (1946), Provence and Lipton (1962)), all point to the critical importance of social interaction for normal affective functioning. The data of such studies have been taken by most developmental psychologists to demonstrate the extreme importance of child-caregiver interactions in the realisation of the full potential of the child. Development of a theory of emotion that is related to cognitive goals, could allow the specification of just what aspects of the environment are essential for emotional development and why.

The Application of ACT to the Development of the Fear Production System

To illustrate the application of ACT, consider the situation of fright (induced for example by seeing a masked man with a gun). Figure (6-2) provides an ACT solution structure that would be involved in such a situation. Table 6-1 lists in full the production set involved. Here we will step through the production sequence assumed to

FIGURE (6-2). A REPRESENTATION OF THE FLOW OF CONTROL IN REACTION TO AN UNEXPECTED FEAR INDUCING EVENT.

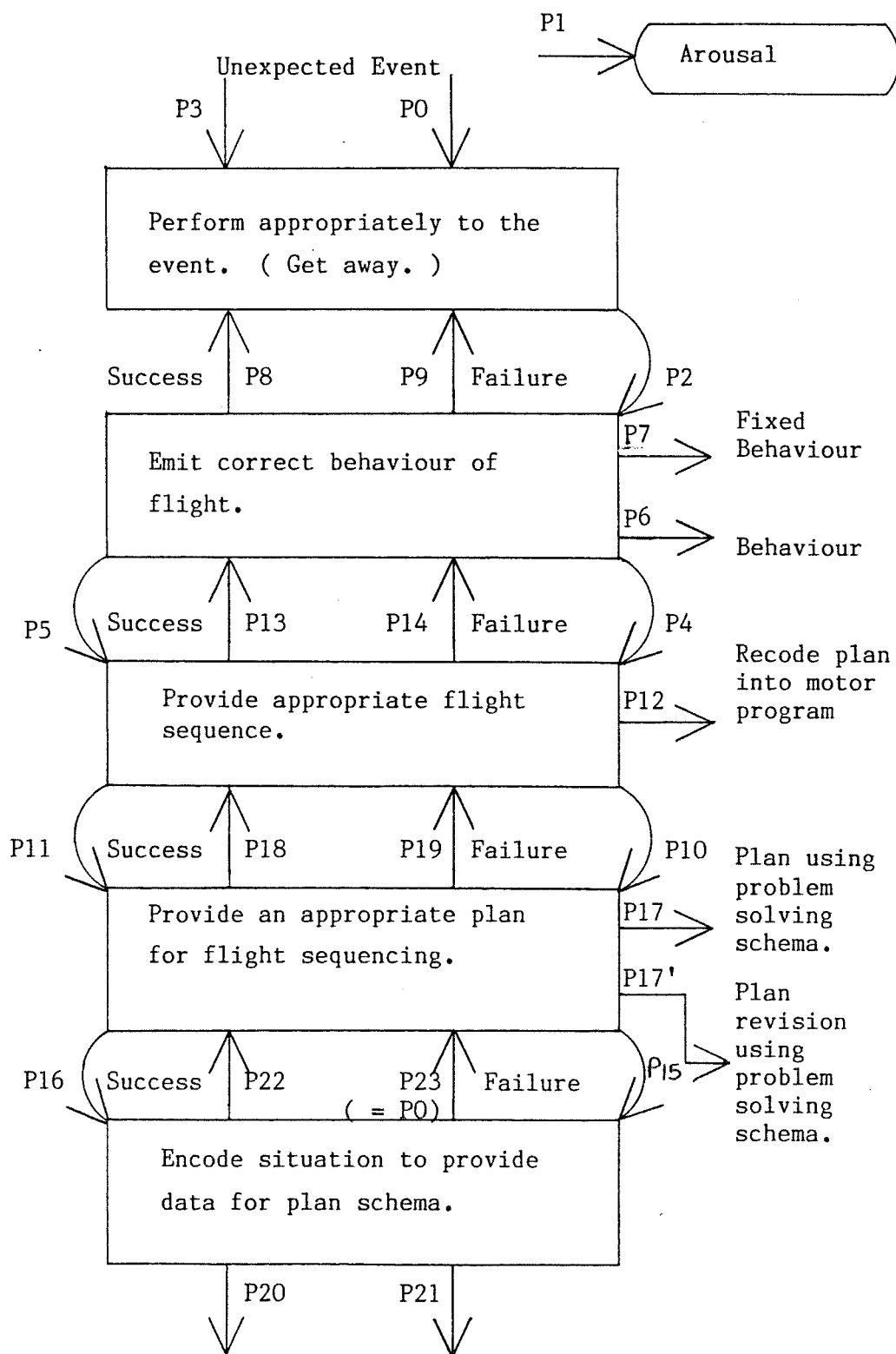


Table (6-1)

Productions Evoked in Fright Reaction.

- P0 IF an unexpected event occurs,
 THEN set as subgoal to react appropriately to the event.
- P1 IF an unexpected event occurs
 THEN increase arousal level
- P2 IF goal is to react appropriately and action is not
 occurring
 THEN set as subgoal to emit appropriate behaviour.
- P3 IF goal is to perform appropriately and unexpected
 event has been coped with
 THEN POP the goal with success.
- P4 IF goal is to emit the correct behaviour for flight
 and there is no flight plan
 THEN set subgoal as providing an appropriate flight
 sequence.
- P5 IF goal is to emit the correct behaviour for flight,
 and flight sequence is completed
 THEN provide more flight sequences into motor control
 system.
- P6 IF goal is to emit correct behaviour and an
 appropriate flight sequence is completed
 THEN run the motor program.
- P7 IF goal is to emit correct behaviour and there is
 no motor program, and urgency is high; or plan
 impossible
 THEN use primitive behaviour programs.


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P8      IF    goal is to emit correct behaviour and a
          behavioural program has been run
      THEN POP with complete
P9      IF    goal is to emit correct behaviour and a
          behavioural program has not completed
      THEN POP with incomplete.
P10     IF    goal is to provide an appropriate flight sequence,
          and there is no plan
      THEN set as a subgoal to design a plan.
P11     IF    goal is to provide an appropriate flight sequence
          and more is called for
      THEN return to plan.
P12     IF    goal is to provide an appropriate flight sequence
          and plan is formed
      THEN recode the plan into a motor program.
P13     IF    goal is to provide an appropriate flight sequence
          and a motor program has been encoded
      THEN POP the goal with loaded.
P14     IF    goal is to provide an appropriate flight sequence
          and there is no sequence available
      THEN POP the goal with empty/imcomplete.
P15     IF    goal is to provide an appropriate plan for flight
(P16)      (plan-unpredicted)
          sequencing and there is insufficient data
      THEN set as subgoal to encode situation.
P17     IF    goal is to provide an appropriate plan for flight
          sequencing and there is sufficient data
      THEN plan using problem solving schema.
P171 IF    goal is to provide an appropriate plan for flight
          sequencing, and a plan exists
      THEN place data in plan, and dissolve plan if they
          have a poor fit.

```

P18 IF goal is to provide an appropriate plan for flight
 sequencing and a plan has been obtained
 THEN POP goal with success.

P19 IF goal is to provide an appropriate plan for flight
 and no plan has been obtained within the time
 dictated by urgency
 THEN POP goal with failure

P20 IF goal is to provide data for plan
 THEN allocate attention according to demands.

P21 IF goal is to provide data for plan and plan is
 partially performed
 THEN provide data so as to compare projection with
 actual.

P22 IF goal is to provide data for plan and data is
 obtained
 THEN POP goal with obtained.

P23=0 IF goal is to provide data for plan and data is not
 obtained
 THEN POP goal with uncertain/unexpected and increase
 arousal.

underlie such an event.

Initially, the unexpected event which is not predicted (or predictable) within the current situation schema, is classified as such and the level of endocrine arousal is boosted (P1). The operative goal becomes that of 'getting away' from the event (in this case the man with the gun). At this stage, it is assumed that there has not been a full processing of the situation, and what has essentially happened is the interruption of other ongoing programs by the registration of an unexpected event.

Production P2 sets the subgoal of emitting some form of behaviour that might result in the realisation of the first goal. Production P7 provides a fixed behavioural pattern that might be used in the situation in cases of great urgency¹. In cases of lesser urgency, the fixed behaviour patterns are not released, and behaviours associated with plans that provide more certain escape are substituted in production P6.

If urgency is at a sufficiently low level, production P4 passes control to a subgoal of providing an appropriate flight sequence. This flight sequence is provided when a

¹ It is envisaged that urgency is a function of the level of arousal. The level of arousal is set by the integration of the separate arousal increments produced by partially processed semantic features that are unpredicted by current anticipatory schema and plans. The levels of arousal produced by unmatched features is a function of the previous emotional significance of these features, and their relation to the current interpretative frame.

feasible plan is recoded into a motor program by production P12. In the event that there is no plan, production P17 creates the plan, with the local variable of the goal of avoiding the object of fear bound as the objective of the general problem solving production set. In order to plan, from time to time there will be enactments of various problem relevant encoding goals and these are set by production P15. For the example of the man with the gun, the problem solving will quite likely have a solution of 'bolt if he starts to point it', and the possible escape routes. There will be behavioural contingencies such as freezing and making no sudden movements while the man is not obviously threatening. This scenario demands the constant monitoring of the situation to check that the predictability of the situation is being maintained by present behaviour. It is important that if the situation changes to be unexpected given the present prediction, that there is rapid advancement to the next stage of the plan or a rapid replanning. Production P16 provides for intermittent matching between current plan and data. Between them, productions P15 and P16 are responsible for the allocation of attention in the current situation. For the man with the gun, a disproportionate amount of processing resource might be allocated to the hand with the gun since the plan is contingent on what happens to that hand. Productions P20 and P21 are the productions that carry out allocation policy.

Several other points should be made about the model. Firstly, it is an interactive model with the flow of control passing from higher level goals down to lower level goals and then back to higher level goals as the coping behaviour

develops . In this way as it takes multiple passes at the situation it bears a superficial resemblance to the model of stimulus matching developed by Krueger (1978). Productions P5, P11, P16 are concerned with the later passes through a situation.

Secondly, each level of subgoal has productions that return to the level of subgoal immediately above, when the outcomes of the other productions of that goal level and below furnish the necessary conditions for popping that immediate goal with success or failure. Thirdly, the model is couched in very general terms with no specification of the particular problem solving mechanisms (e.g. imagery algorithms, verbal algorithms) that are used. Allowances for individual differences in subjects can be made in the model by postulating that subjects develop their own unique problem solving heuristics for each emotion.

Fourthly, a non obvious aspect of this model is the way in which it incorporates the suggestion of Tomkins (1962, 1980), that arousal serves as the activation of affect. Tomkins suggests that the density of neural firing, and its variation with time determines the emotional meaning that is given to an event. In the model of figure (6-2), production P23 returns the signalling of an encoding failure - either because the data predicted by the plan was absent, or because the data required for planning was not available. In either case, the mismatch produces an arousal increment which if of sufficient magnitude may signal the occurrence of an unexpected event and produce a rapid resetting of the performance goal of the production set. The mechanism by which pattern mismatches can produce rapid resets of encoding fields has

been discussed extensively by Grossberg (1980, 1982b). It can be seen in light of this discussion that the production P1 that produces arousal when an unexpected event occurs, is included only for the purpose of making an explicit connection between an event and arousal, and in fact the 'unexpectedness' code is the level and rate of change of arousal. Thus, production P1 can be removed from the model provided it is understood that an unexpected event is by definition an event associated with a change in the arousal gradient.

Fifthly, an understanding of positive affect in terms of coping is implicit in this model of affect. As is pointed out by Lazarus, Kanner and Folkman (1980), approaches that view positively toned emotions solely as end-states of successful adaptation are erroneous, in that positively toned emotions can also signal the need for coping, and can also sustain coping activity. The present model can account for the positive affect produced by mastering activities such as learning movement skills, by assuming that any performance goal can set up a subgoal structure analogous to figure (6-2) and thus determine behaviour. Positive affect arises when a behavioural plan is seen to cope with environmental contingencies. Traditional reinforcement theory predicts a preference for reinforced behaviour (cf Hilner, 1979). Thus the development of successful mastery of a skill will be itself the reinforcer of sustained use of that skill.

Lazarus details three basic physiological functions of positive affect: as breathers, as sustainers, and as restorers. In the present ACT model there is a correspondence between these three functions and different points of time in the

processing of a performance requirement. Breathers occur when well learnt and actionable plans are engaged in, sustainers occur when plan segments are completed resulting in positive affect, and restorers are a contrastive effect of substitution of small, realisable plan sections for a previously failed plan. The production system model presented here, highlights the possibility that there is considerable cognitive control of the physiological consequences of emotion.

Differentiation of Emotional States

An important requirement of any theory of emotion is that it be able to specify the ways in which the states associated with various affect labels differ from each other. For at least one theory (Schachter & Singer, 1962), the label is implicated as the differentiation of emotions. Here, especially for positive affects the ACT model might seem to lead to the same conclusions. For, in postulating that positive affect is associated with plan formation, implementation, and a resulting coping perception, it would seem that there is little to differentiate affects apart from the situations that they apply to. But here, anyone who has felt negative affect in a patriotic sports crowd knows that there are no unvarying situation-emotion assignment rules, and so the stimulus cannot be a sufficient attribute set to differentiate emotions. Rather than succumb to a position that emotional states are what you label them, instead, the planning aspect of the model put forward here allows an account of the ongoing processes that differentiate emotions. Of course, the gradients of arousal have already been discussed as being differentiators of emotion, but it is

obvious that the limited set of these will not be sufficient to differentiate the bulk of emotions; accordingly the discussion will now consider the way in which the plan can characterise emotions.

The proposition put forward here, is that the affects can be differentiated by the plan solution constraints which are associated with the various emotions. It is proposed that humans have such a wide range of affects, because culture and socialisation produce solution constraints which mimic the solution constraints associated with the biologically fundamental emotions. For instance, pride and satisfaction are both possible outcomes of goal completion, but in terms of the plans that led to the goal completion, it is plausible that prideful outcomes are associated with competitive goals, whereas satisfaction derives from more behavioural goals. Thus, while the goals set might result in equivalent plans in the case of pride and satisfaction, these goals will mean that the solutions incorporated in the plan are derived in different ways. The perfection of a basketball move by a basketball player will result in pride where the move provides a solution constrained to be in accord with an increase in degree of publicly agreed on worthwhileness. On the other hand, the same move perfected as part of a solution to increasing winning probability, might not produce feelings of pride, but rather feelings of satisfaction. Whether or not pride or satisfaction will be felt after a particular behaviour on mastery of the problem (the move), will be dependent on the specific objectives brought to the problem because these objectives define the encoding that will be given to the completed problem.

Some Puzzles Answered by the Model

The present model makes clear the reason for the apparent strength of emotion relevant encoding as evidenced by the work of Bower and his Colleagues (e.g. Bower, 1981; Bower, Gilligan & Monteiro, 1981; Bower & Cohen, 1982), and Teasdale and his colleagues (e.g. Teasdale & Taylor, 1981; Clark & Teasdale, 1982). Encoding will be deepest and information most processed, for those parts of the information field that are most relevant to the problem of current concern. This is because the planning stage of the model calls for this kind of information both initially in plan formation, and later in plan monitoring. Therefore, it is predicted that mood at encoding will affect the content of the material of an episode, but apart from providing an intermediate association, mood at retrieval will not affect the proportion of correctly recalled material.

The prediction is borne out, in that it has been found that there is a major influence of mood at encoding on recall, but it is very difficult to demonstrate an influence of mood at recall on recall success (Bower et.al., 1981; Bower, Monteiro & Gilligan, 1978). Even where a successful effect of mood at recall has been demonstrated, the effects can be subsumed as response bias effects (Natale & Hantas, 1982). The response bias towards recall of emotion congruent material most probably accounts for the effects of studies requiring recall of past experiences (e.g. Teasdale & Taylor, 1981), and in any case such results cannot be compared with those of Bower and his colleagues as they do not require exhaustive search of a specific episode. One other piece of research (Teasdale & Russell, 1983), has found evidence of a recall

advantage for the mood congruent words in a word list. However, the list was not composed of only neutral words that had their emotional significance prescribed in an earlier episode manipulated by the experimenter, but trait words that are very likely associates to mood states. Thus, it was a list of words with members that could be associated to the current mood, and not surprisingly the subjects took advantage of the retrieval aid. (It is likely that the salience of mood as a retrieval aid was very high in this experiment, since the purpose of the experiment was explained prior to list learning).

The ACT model explains the pervasiveness of the three dimensions of the semantic differential in the following manner. After information reaches the peripheral receptors of an organism, its amount of processing will be determined by the extent that it is relevant to current and stored goals. Thus the planning and plan monitoring nature of cognition demands the differentiation of relevant and irrelevant information. There are certain basic processes that perform this differentiation. ^{It is these processes which give rise to} the dimensions of the semantic differential. The dimensions of the semantic differential reflect the kind of information which is important to plan monitoring processes.

Consider the three response dimensions of the semantic differential separately. Evaluation (good vs bad) is obviously of importance in deciding which environmental elements will threaten, and which facilitate plan performance. Potency (strong vs weak) has to be established in order to be able to assemble plan elements which are capable of achieving goals. Activity (lively vs still) is the type of

information which is relevant to the development of an efficient plan monitoring process. There is no utility in monitoring parts of the plan environment which have fixed performances.

Thus, the ACT model of emotion suggests that there are fundamental information processes through which incoming information can be roughly matched with current concerns. The ubiquity of the dimensions of the semantic differential reflects the fact that all information undergoes these processes. The ACT model does not suggest that the dimensions of the semantic differential are the best dimensions for describing affect. Instead, the model suggests that the dimensions of the semantic differential are the most useful dimensions for relating information to the plan heuristics of the various emotions.

Another puzzle that the ACT model helps to clarify is the influence of feedforward of sensation information on the level of emotion felt by subjects. The classic emotion misattribution paradigm of this kind is exemplified by a study by Nisbett & Schachter (1966), where a subject is given a placebo pill and the shock produced arousal symptoms are attributed to the pill by the experimenter (in the case of the misattribution condition). Under such conditions, the subject tolerates more severe shocks, and they are reported as less painful than for control conditions with symptoms other than arousal symptoms attributed to the pill. Leventhal (1980, 1979), and Calvert-Boykowski and Leventhal (1975) have questioned the misattributionist interpretation of these results, and Calvert-Boykowski and Leventhal's research has shown that it is the drawing of attention to

arousal symptoms that contributes to this lessening of emotion, and that a neutral attribution is not required. Leventhal (1980, 1979) argues that the results in the classic misattributionist paradigms have a confounding symptom information factor that coincides with the misattribution factor. Leventhal argues that it is the symptom information that often gives rise to the results. The impressive data that Leventhal has collected on distress control (reviewed in Leventhal, 1980), support his interpretation of the misattribution paradigm, and suggest that giving accurate feedforward of sensations, and a benign interpretation of sensation can result in pain reduction.

The ACT model also predicts that negative affect will be reduced, to the extent that a plan or schema has been formed, with a coping outcome, and capable of integrating the information to hand. The ACT model does predict that it could be important whether attribution of arousal is made to a benign, or a noxious stimulus, but only in that the respective attributions will affect plans and plan success criteria. In accord with this prediction, Reinhardt (1979) showed that distress reduction in sensation monitors only occurred for those subjects who expected pain sensations to lessen over time. As interpreted here, it is only in the group with expectations of a pain buildup and decline that the occurrence of the build-up of pain and other physical sensations is ⁱⁿ accord with a plan schema that predicts a coping outcome.

One other puzzle, that the ACT model is relevant to, is the problem of identifying the stimulus conditions that will lead to positive and negative affect. It is far from

obvious how a strong emotion will originate. The conditions, in as much as they can be specified for positive affect, have to be expressed as generalisations which are referenced to the individual. There seems little in common amongst the goals that when realised result in positive affect. Two extreme examples demonstrate this point; Lazarus, Kanner and Folkman (1980), relate how to Poincaré the mathematician, creative mathematical ideas were those ideas which he found most emotionally moving; secondly, Leventhal (1982) discusses the case of a terminally ill patient who experienced great joy from the accomplishment of simple tasks mundanely easy to most people. In both these cases, the accomplishments were solutions to uniquely individual goals and the affect experienced seems proportional to the importance of the goals.

The ACT model predicts the individuality of emotional stimuli, as the occurrence of positive affect is associated with goal completion, and as indicated by Anderson, much of learning is associated with fulfilment of general problem solving goals, applied to individual problems. The ACT model postulates a set of innate performance goals that give rise to the fundamental emotions, but it links affect with attempting any performance goal, and thus provides for the individuality of emotions. By linking affect and learning explicitly in this way, it goes further than most existing emotion theories which are hard pressed to explain such phenomena as those discussed above, and the more exotic entries in the cognitive literature such as 'flashbulb

memories' (Brown & Kulik, 1977), and 'mental shock' caused amnesia (Loftus, 1982). (Flashbulb memories are accounted for by the reprocessing of elements in the current situation in order to ascertain that the current plan is still coping. Mental shock caused amnesia is a consequence of differential reprocessing of event-central elements that because it limits rehearsal of non-central information produces retrieval deficits.)

Experiments Reported Here in Light of the ACT Model

Briefly, to summarise the results of the three experiments reported earlier.

- 1) It was found that under conditions of high arousal the disruptive influence of subliminal emotionally disturbing words was eliminated. (Chapter 3)
- 2) Some evidence was found that suggested there might be an association between well-being/positive affect and a decrease in information processing of threat associated stimuli. (Chapter 4)
- 3) It was found that attention in the visual field is allocated first to that region of the visual field that is congruent with the momentary affect.
(Chapter 5)

Together, these experiments point towards changes in the availability of certain types of information as a consequence of affect. They are consistent with late selection theories of information processing which suggest information is first processed automatically, and later this information base is selected from and a limited amount of information is made available to conscious processing.

The most comprehensive account of this position is provided by Marcel (1983), who postulates that automatic processes give rise to a variety of perceptual records at various levels, and these records are searched for elements that match current perceptual hypotheses. This idea of a full automatic processing of all sensory data has been suggested also by Deutsch and Deutsch (1963), and Norman (1968). Glass, Holyoak and Santa (1979) develop the idea to suggest that this processed but unattended input is monitored by an attention controller that will divert conscious attention to it, should it represent a significant change in input.

The ACT model developed in this chapter, suggests what is meant by a 'significant change in input'. It suggests that a significant change in input is related to the heirarchy of plan schema, and the absence of input-matching expectancies generated from such plan schema will cause a change in patterns of attention allocation. The results of the above experiments are in accord with a second principle of the model; that information must be relevant to the goals of the current emotional state to benefit from the allocation of attentional resource. The ACT model then, goes further than the semantic network model of Bower (1981), in that it predicts that associated with the occurence of a particular affect, a monitoring program will be implemented. The data of the current series of experiments especially the attention experiments are congruent with such a monitoring program having been implemented.

The semantic network explanation might also predict the results of the three experiments listed here. It could do so, if it were supposed that attention is a function of

pathway activation (Posner, 1978), and excitation of an emotional node increases activation of all pathways connected with the node. However, two major criticisms of such an account, one philosophical and the other empirical, lead to the conclusion that in terms of scientific virtuosity, the semantic network model does not account for the current experiments as well as the ACT model.

a) Firstly, the semantic network account of attention allocation is to some extent circular. What counts as evidence of pathway activation is also what counts as evidence for an emotional node being connected. For instance, while the subjects ratings might indicate the level of activation of an emotional node, the semantic network account rests easily with any pattern of results that show consequent deficits and benefits. The explanation in all cases is in terms of the activation pattern within the semantic network. Thus, no pattern of results is unpredicted by the semantic network account and the theory as applied to emotion is essentially unfalsifiable.

This serious criticism of the semantic network theory does not mean that the use of a network model as a conceptual framework should be abandoned. It merely highlights that the semantic network model is primarily a metatheory (Sternberg, 1983), that furnishes a language with which to develop theory. What is a requirement within any meta-theoretical framework is the development of specific theory. The ACT model developed here does that, as does the blackboard model of Bower and Cohen (1982). However, the blackboard model is more limited because at present it only accounts for emotional memory, and it does not make specific

predictions about attention allocation.

b) Some of the data of the present series of experiments are not obviously accommodated within semantic network theory. For example, the first attention experiment found evidence that an affective state will bias attention allocation in the processing of a field of letter stimuli. Now, prior to the experiment the letters would have had affectively neutral associations, so that the sudden emergence of a letter-emotion node connection seems fortuitous, even surprising. The ACT model predicts the formation of specific situational monitoring assemblies, and can far more readily accommodate the findings.

As well, the correlation between the reaction time increases to anger stimuli, and the level of joy experienced in the second experiment of chapter four, was negative, indicating the more joy, the less interference from threat related stimuli. This result is consistent with a spread of inhibitory activation about the network for anger related nodes. But it is assumed that while emotion nodes operate inhibitorily with respect to one another, that they operate in an excitatory manner with respect to the network (Bower, 1981). Thus, the result can be accommodated by a semantic network account, but it requires the existence of two types of activation within the network. The ACT model also has some problems with this result, because it predicts that most emotion incongruent material will be rejected by the monitoring program, and it is hard pressed to explain why for happiness states this seems to happen most for threat related stimuli. It could be that only for these stimuli was the immediate significance of the stimuli sufficiently

strong for a link with the conceptual node to be made early. The results of Chapter four were the least conclusive of those reported, and so should, possibly be overlooked.

An Analysis of Two Real Life Elicitors of Emotion

To demonstrate further, the usefulness of the ACT model, we now consider the application of the model to sport and gambling.

Sport and Emotion

In sport, a unique environment is provided for participants and a set of behavioural goals is furnished. Competitive sport has the ultimate goal of winning, and frequently, the winning or losing of a game is a point at which strong affect is felt. A wide range of emotions may emerge in sporting competition, from a sense of anger at ones opponents to a deep sense of joy. A bad shot played while practising may elicit an entirely different momentary affect state than the same shot played in a game. In practise, the bad shot may elicit disappointment/distress, while in a game there may be intense anger.

According to the ACT model, the kind and intensity of emotion will be determined by three factors; the goal set, the problem solving heuristics, and the monitoring criteria. We demonstrate the influence that each might have on the emotions experienced during a sporting encounter.

I Sporting Goals

The sports arena foisters situationally determined sporting goals on the individuals involved. Often the superordinate goal is that of defeating the opponent, and

the moment to moment goal structure is composed of secondary behavioural goals to that end. To the extent that the secondary behavioural goals prove inadequate for achieving the superordinate goal of winning, the player will be experiencing negative affect states. This proposition is qualified by the fact that the superordinate goal of winning may not be a realistic goal, and there may be a replacement of that goal with more realistic goals such as gaining sporting experience. Thus, a large loss may be commensurate with sporting goals, or incommensurate with sporting goals. It is the goals, not the fact of loss that is critical in the extent to which events are unexpected, and the extent and direction of affect felt.

II The Problem Solving Heuristics

Where a mismatch between events and goals occurs, there is implementation of problem solving heuristics. Critical for determining which problem solving heuristic is implemented, is the attributional structure that surrounds the unexpected event. Weiner (1982) has detailed an attributional framework that provides the 'causes' preceding each major emotion. It is suggested here that one reason there is a causal structure associated with the emotions, is that the emotions have characteristic problem solving heuristics associated with them, and it is the causal structure of the situation that determines which heuristic is called into play. A number of other factors will influence what heuristic is used including (1) Availability of heuristics; a currently used heuristic is more likely to be applied to a situation than a new heuristic. (2) Experience of previous applications of the heuristic; a previously successful heuristic is most

likely. (3) Compatibility of the heuristic with other aspects of the situation; heuristics associated with anger, are far less likely to be used when an encounter is with someone emitting signs of friendliness, than with someone nondescript or unfriendly.

To make the considerations mentioned above more concrete; they are reflected in real life by the anger induced in intense sporting competition. It is predicted that early anger makes it much more likely that a fresh opponent will also be subject to anger. Secondly, where (say in a rugby match), anger has resulted in a more vigorous approach to play and consequent success, it becomes likely that entire matches come to be played with its heuristics operational. Lastly, there is considerable emphasis placed on sportsmanship in most games, and a gracious opponent is far less likely to provoke intense ire, when he/she wins.

III Monitoring Criteria

Lastly, the ease with which an intense affective state may be overcome will be a function of the monitoring criteria used to evaluate progress towards goals. These monitoring criteria vary depending on the extent to which plans can be composed that involve considerable sequences of actions and may be long-term in completion. Critically, what might be deemed as unsuccessful short-term behaviour can be taken as coping sufficiently towards long term goals. Accordingly if it is chosen to monitor short-term coping indicators, negative affect might be felt. Whereas, the same person, with the same information available might feel positive affect if they are monitoring long-term coping indicators.

As a concrete example, consider the athlete running a

race in which he/she is not placed. There may be disappointment if the athlete uses placing as the critical variable for monitoring performance. But, if the athlete's goal is to win some later race, and the time taken is in line with that goal (given the training schedule), then the performance might be the source of considerable satisfaction. Thus, individual differences in choice of critical monitoring variables can produce considerable differences in the emotional state evoked by a situation.

It should be made clear that when the last paragraph refers to 'choice' of monitoring variable, this is not to infer that there is a conscious decision on that matter made by the person. Rather, the choice of monitoring variable will be a consequence of the structure of the plan devised by the called problem solving heuristic and the set of monitoring skills which can be evoked. That is to say, monitoring is envisaged as a natural part of plan implementation, and it proceeds automatically once a plan is implemented. This aspect connecting plan and plan monitoring means that the present model is congruent with the observation of Averill (1980) that emotions seem more reflexive and passive than does normal rational thought. In normal rational thought, an implemented plan will be monitored when the planner decides; under emotion, plan monitoring is compulsive in accord with the priority of the goal, and the need for rapid learning. (Simon (1967), notes the characteristics of emotion of goal priority, and rapid goal directed learning.)

Gambling and Emotion

The analysis of gambling as an elicitor of emotion follows very much the same lines as that for sport. The gambling situation is characterised by the frequency with which goals are set, uncertainty induced planning to meet goals occurs, and plan fulfillment/failure is signalled. One aspect of the heuristics used to devise plans is demonstrated in gambling behaviour; typically intense considerations take place, not merited by the possibility of solutions that have any influence on positive outcomes. This compulsive planning indicates that the operating heuristics are set to work on ill defined problems and as suggested by Simon (1982), they employ weak methods to arrive at solutions which as a consequence may be inefficient.

It would seem that anything less than a model of emotion that accords critical place to goal matching, will be hard-pressed to explain the range of emotions possible to interactions with things as impersonal as 'one armed bandits'. Certainly, analysis of gambling in terms of schedules of reinforcement, and the distinction between positive and negative reinforcers is not adequate to encompass the range of emotions that gambling situations evoke. At best, a behavioural analysis promises to explain the gamblers perserverance at gambling, but such an analysis of gambling falls short of being able to account for the patterns of thinking and attention allocation associated with the situation. The ACT model of emotion presented here promises to be capable of making predictions about these aspects of the gambling experience.

Conclusions and Implications

In this chapter, an attempt has been made to expand a framework that links affect and cognition. The ACT model of emotion put forward, emphasises emotion as having the function of facilitating the organisms pursuit of essential goals. It has much in common with the theory of emotion put forward by Simon (1967) in that it emphasises affect as intimately linked with the extent that important goals are matched. It is distinguishable from Simon's model, by the emphasis on emotions as characterised by their plan heuristics rather than their goal resetting character. Indeed, the present model does not require that there be a resetting of higher level goals in order for affect intensity to be higher. The highest levels of negative affect will occur when the affect congruent goals are in place, and there is no evidence for coping by means of the current behavioural program. Thus, as with Scheier and Carver (1982), the present model places emphasis on 'expectancy assessment' rather than 'goal-value'. It is the expectancy assessment (or in the terms of this model the plan monitoring), that is critical to the level of felt affect.

The major consequences of a goal hierarchy of the kind proposed here, and the ongoing plan monitoring incorporated are -

- a) The organism is equipped to react to urgent situations with plans/plan heuristics that have the most probable chance of extending organism survival.
- b) Attention is allocated in the perceptual and informational fields in such a way that the contingencies in the environment are referenced to certain key outcome parameters. In this

way, the learning of the environmental relationships of importance for essential survival functions is facilitated.

It can be seen that in the two emotion mechanisms above, there is the integration of genetically encoded sources of information with information that accrues from behavioural and cognitive operations on the environment. This accords with the emphasis of the current chapter - that emotion facilitates adaptive learning, or perhaps reflects the organisation of the processes involved in learning in such a way as to ensure adaptive learning.

The accounts of the earlier experiments were reviewed, and it was seen that these results are congruent with the ACT model, and an adaptive learning account of emotion. It was also demonstrated that the ACT model can be applied to sport and gambling to account for the intensity of emotion experienced by participants.

Implications of the Model for Emotion Theory and Personality Theory

The ACT model of this chapter bears resemblance in some ways to models put forward by Simon (1967), Klinger (1982), Schier and Carver (1982), and Bower (1981). While it has some elements in common with other models, there are implications of this model which are not easily derived from the others. Firstly, the present model avoids the separation of an emotion system from other cognitive and physiological systems. Thus unlike other approaches with a system philosophy such as that of Royce and Diamond (1980), the effects of emotion are not conceptualised as the operation of one system upon another, but are regarded as

essential attributes of a multifaceted state of preparedness. This way of looking at emotion discourages pseudo explanations that are akin to word magic (cf Berkowitz, 1975, p.57), and encourages the analysis of the coordination of information processing and behavioural functions that is evident in the states which we label emotions.

Secondly, in associating emotions with different prototypical plan heuristics, the ACT model of this chapter recommends the analysis of emotions in terms of specific problem solving sets. Apart from the work of Isen et.al. (1982, 1983) and work by Johnson & Tversky (1983), little research has been done into the way that emotional states influence decision making. The present model points towards a field for investigation that has not been indicated by the other models. A full program of research should be conducted into the variation in means-ends analyses that occur in attempts to solve various ill-defined real life problems. Different emotions will be associated with different means-ends analyses (Simon 1979) and different goal structures if the present model is correct. (One very good example of the way in which means-ends alter with emotional state, is seen in the behaviour of novice computer programmers. Persistent programming difficulties tend to lead to a personification of the computer, and a greater tendency to attribute the program failure to computer error. The coincidental emotion in this example is anger.)

Thirdly, the present model suggests the basic framework of an integration of personality theory, emotion theory and learning theory. Chapter two, discussed personality. and suggested that there were sound reasons (to do with

system modelling), that a conceptualisation of personality in terms of the microprocesses underlying emotion should be attempted. In chapter two, it was considerations of the modelling of concrete systems that led to these conclusions, and differences in temperament seemed to correspond to a concrete system domain which could be perhaps modelled by a set of fundamental microprocesses. The second chapter noted that while the microprocess assembly model was pitched at the temperament end of personality theory, it could have implications for acquired personality characteristics as well. The ACT model of emotion makes it clear that acquired personality characteristics will arise as a consequence of the learning processes that are associated with the heuristics of goal attainment/attainment failure.

For example, a trait of punctuality may arise because it is a part of a plan that overcomes rejection fear. Initially such a trait, and its monitoring pattern will be specific to situations which require time monitoring in order to minimize the danger of not meeting conventional situational requirements, and the trait will not always hold when fear relevant plans occur. But, if rejection fear is pervasive enough, then ACT's knowledge compilation characteristic will build time monitoring into the heuristic associated with rejection control. Such a modification of a coping heuristic will bring about shifts in the higher level behavioural goals over time, and eventually a pervasive influence of punctuality on behaviour.

One final point should be made. A complex interactive model such as that put forward here is not easily established as preferable to simpler models. Without research into

whether solution heuristics can be discerned that correspond to the fundamental emotions, the only factors that really recommend the ACT model, are that it seems to account readily for the experiments into emotion reported here and elsewhere, and it seems to describe the goal relatedness of much emotional experience and more readily than most other models. Certainly, much of the history of psychological theory is examples of the early putting forward of models that do not seem to have obvious advantages over others. The present model is put forward with that acknowledgement, but with the belief that future advances in cognitive learning theory and sociobiology will be more compatible with the ACT model of emotion than with most others.

Conclusion: Old questions, old answers, new methods.

The Enquiry

This thesis has enquired into two fundamental questions. It has asked what is an adequate theory of emotion? Secondly, it has asked how we should set about constructing a well founded theory of personality? Of course, since these questions are so fundamental, the enquiry and research presented in this thesis is just one of numerous attempts to analyse those questions. The present thesis has only scratched the surface of some of the issues involved in accounting for emotion and personality, but it has scratched it in a way that is perhaps a little different from most other approaches. There are three main ways in which this thesis can be considered to differ from other studies:

- 1) It has attempted to utilise the foundational principles of sociobiology and behavioural genetics in theory construction.
- 2) It has provided experimental evidence of the functionality of emotion as it relates to attentional/perceptual processes.
- 3) It has used a convergent experiment to check the validity of semantic network theories of emotion.

In terms of the extent to which the unique approaches outlined above have been fruitful in extending and clarifying knowledge, each approach has borne different fruits. The check on the semantic network theory produced results that were less than clear cut, and it is plain that further research into that theory is necessary. It is essential that semantic network accounts of the influence of mood on

memory be confirmed through data obtained by employing direct methods of showing network activity such as the Warren task (Chapter four), or the lexical decision task (Meyer & Schvandavel, 1971).

The experiments that demonstrated attention reallocation in the visual field as a consequence of emotion were more successful. Although considerable demands on experimenter ingenuity are required to research the attention allocation-emotion relationship, the area looks particularly fruitful. In particular it is possible that the phenomenology of emotion can be accounted for in part by the evidence for a change in priority of inputs in the perceptual field.

The first of the points of uniqueness listed above, is the most surprising one in many ways. It was surprising to find in looking through the range of approaches to human emotion and personality that there was no major theory that took its account from a consideration of the evolution of emotional and cognitive behaviour. Many theorists (e.g. Izard 1977, Plutchik 1980, Lazarus 1980), incorporate considerations of the functionality of emotional behaviour, and emotion related cognitive states, but none have put forward specific proposals about the evolutionary history of the emotions.

The demonstration of the functionality of a particular characteristic or trait is merely a demonstration of the usefulness of a structure, and cannot guarantee an insight into its essential nature. This point is made by Krebs and Davies (1981), when they refer to an illustrative example of G.C. Williams of a Fox making its way to a henhouse in heavy snow. The fox's feet will make a pathway in the

snow which it will no doubt use again in later raids. However, it is wrong to conclude that because the feet have acted as pathmakers, that foxes legs have been selected for that adaptive function. It most probably will prove impossible to show that the foxes legs have been adapted for that purpose, and so explanation of the structure of the fox along these lines amount to story telling and not science. In order to move from story telling to scientific explanation, it is necessary to consider the total set of functions and also to be able to trace the advantage enjoyed at any one period of time to a particular structure.

Theorists such as Plutchik have put forward feasible accounts of some of the ways that emotions can function, but unless there is a more rigorous evolutionary account then this is a social explanation of the emotions, and not a biological account. The account put forward in chapter six, built upon an account by Klinger (1982) and went on to consider the development of emotion as a signalling system, and the reduction of its stimulus specificity in favour of its application to internal goal structures. Obviously this evolutionary sequence, derived from consideration of the advantages bestowed by specific changes in behaviour and information processing at various places in the evolution of a species is highly speculative. However, attaching a statement of an evolutionary sequence to propositions about emotional functionality is justifiable on several counts -

a) It represents a legitimate use of evolutionary theory to derive ideas about how human beings could function (Patry, 1983).

b) Since it is more specific in why and how functions

emerged, it is more testable than a bald statement of functionality.

c) It derives more than accounts of functionality: it also suggests the structure of the mechanisms whereby functions are achieved. Thus, in the case of the theory presented in Chapter six, the nature of the interactions between the cognitive system and the emotional system are suggested.

d) It is an attempt at a level of biological explanation that must ultimately be attempted. Tinbergen (1963) in noting that there are several different ways of answering 'why' in biology suggests that an account in terms of evolutionary history is one kind of answer. For a complete explanation of any behaviour/information processing tendency, all levels of explanation should be attempted.

Directions for Personality Research

The attempt to look for evolutionary functions of emotion led to conclusions that are of relevance to a concrete system approach to personality. Chapter 2 argued that one of the vices of extant personality theory is the tendency of theories to be formulated in terms of abstract systems which while they may explain subsets of behaviour, cannot be linked to a general theory of living systems. The solution for personality theory suggested in Chapter 2, was to employ the constructs that derive from the operation of concrete systems (biological systems) in order to account for behaviour. A method towards this end was suggested; define the set of fundamental constructs of personality in terms of microprocesses that can be shown to have a demonstrat

inherited component. Differences in personality might be accounted for in the characteristic ways such microprocesses are assembled for coping with the environment. Thus, Chapter 2 opted for analysing processes at the temperament end of personality theory. Chapter 6, with its theory of emotion has suggested just what kind of assemblage might underlie personality differences, and how the assemblages can influence the cognitive structures that represent the world and control action.

Chapter six's ACT model of emotion suggests that there is a particular problem solving set associated with each emotion. In terms of the various manifestations of personality then, provision of a particular set of goals, and the means of affecting those goals by the emotional system is what underlies personality types. Personality types can result from temperament characteristic ways of employing heuristics when interacting with the world, or because of environmentally induced assemblies that act as solution heuristics. In both cases, the ACT model in incorporating the suggestion that emotions are more goal related than stimulus related, will suggest that associated with personality differences are patterns of environment-affect correspondences that are personality defining.

The research that must be done to establish the usefulness of these ideas about personality and emotion linkages are -

- 1) Investigation of whether there is a correspondence between characteristic affect and behavioural tendencies within situations. (At a broad and general level such research has already been conducted by Mehrabian and Russell

(1974), who show that approach and avoidance tendencies are predicted by the affect producing characteristics of situations, and their interaction with personality variables such as neuroticism and extroversion.) The ACT model though, hypothesises that there are specific problem solving heuristics attendant upon affect, and that these heuristics are the determinants of action sequences. A more detailed analysis of why the affect-behaviour linkage occurs for a situation is required. Specifically, an examination of the problem solving nature of situational cognitions by some form of protocol analysis (cf. Simon, 1979), needs to be done.

2) The extent to which there is a major problem solving heuristic that can characterise an individual in their interactions with a wide range of situations. (See Newell (1980) for the suggestion that problem solving is characteristic of most information processing).

3) Investigation of the influence of problem solving heuristics on the accessibility of the various kinds of stored information which is utilised in other similar situations. That is, does the emotion system produce an organisation of knowledge that will determine the pattern of encounters with new situations? The mood and memory research suggests that it might.

Cognitive Learning, Genetic Learning and Personality

The impetus towards genetically encoded traits and for the concrete system approach advocated here does not originate from a perspective that would minimise the importance of cultural and social learning influences on personality. The guiding principle of researchers of

behaviour who operate along the genetic - environmental causal continuum should be one of where the environment determines behaviour, not whether it determines behaviour. It is important that personality research acknowledge both proximal and distal explanations of behaviour in the same way that Vine (1983) has recommended for social psychology. The area of personality is where distal explanations are most sought, because traditionally it attempts to characterise the organismic properties rather than environment induced behaviour rules. (Though much of personality research since Mischels (1968) paper can be seen as less organism centred). Behaviour prediction is not the final goal of personality research (although it may be the final goal of an approach that integrates personality and learning theory). The final goal of personality research is to understand the functioning of the person, (cf. Royce & Diamond (1980) and here undoubtedly distal accounts are important. The caution of Petrinovich (1973) that the control of 'extraneous factors' pursued in systematic design should not blind researchers to the fact that such designs represent the demonstration of possibilities, rather than the probabilities of representative design, should be remembered. It has been advocated that evolutionary principles and sociobiology can furnish the framework to distinguish in the possibilities of other kinds of experimentation/research, the probabilities relating to functional organisation.

Systems Theory Insights into Theory Construction

The adoption of temperament properties as personality characterisers, and the emphasis on genetically encoded

structures and processes advocated in Chapter two receives support in recent analyses of science from within the systems theory literature. These analyses highlight the importance of establishing a framework that provides a universal insight into the behaviour of the object of consideration. Bordley (1983), suggests that science operates within implicit consistency premises, and scientific laws are those laws which provide the specifications for the maximisation of the utility of behaviour. For Bordley, an entity described by scientific theory maximises a utility function by following the set of laws congruent with such maximisation. Scientific theory can be viewed as specifying the utility of various acts for the entity, the range of possible acts, the set of states and their probability and influence on acts. The problem that this account presents is that the function specifying the utility of acts is almost certainly culture specific at the micro level of behaviour. Thus, there can be little hope of a theory of personality that can account for proximal and distal causes of behaviour across cultures. (The possibility of a proximal and distal account within a culture is not ruled out, but the mapping from culture to individual psychology is not understood or pursued at present by psychologists). The universal framework that might be pursued is one of concentrating on the distal functionalist organisation of the person through the use of an evolutionary approach.

This conclusion is congruent with the work of another system theorist (Glanville, 1982) and his analysis of the explanation and whitening of behaving objects. More so than most other examples, the personality theorist trying to

understand behaviour across cultures is confronted with the problem that his/her means of analysis creates a 'whitening' of a black box (the subject) only by introduction of himself as an interacting black box. Thus, Glanville argues that any whitening creates a new dyadic black box opaque to a new observer. Only by the introduction of the transcendental observer who has simultaneous access to two levels of a black box can the series of boxes and observers be demonstratable recursive and knowable. The analysis of personality in biological functionality terms, would seem to permit scientific consensus at least at the distal level of personality (and emotion).

Forerunners of the ACT Model of Emotion

The aside into the justification of the evolutionary analysis of personality and emotion, does not mean that the model of emotion presented in chapter six is so new that it needs justification in terms of epistemological considerations. One of the striking things about the ACT model of chapter six, is the resemblance that it bears to Spinoza's account of affect. Neu (1977) provides a fascinating analysis of the theories of emotion of Spinoza and Hume, and the therapeutic implications of these and other theories.

Neu points out that Spinoza's theory of emotion and the primary emotions that it postulates, must be understood in relation to the Spinozist concept of conatus which can be interpreted as an effort at self maintenance or in cybernetic terms as the mechanism of homeostasis. Thoughts are essential attributes of emotion, which include thoughts relating to the cause of emotion. Spinoza differentiates

between active and passive emotions which are distinguishable by the adequacy and inadequacy (respectively) of the thoughts associated with each. The distinction between adequate thought where the mind acts, and inadequate thought where it reacts or suffers, is difficult to provide a definition for. An illustration of inadequate thought leading to fear is 'an inconstant pain rising from the idea of something past or future, where of we to a certain extent doubt the issue' (Spinoza taken from Neu p.84). This can be contrasted with the manner of adequate thought that overcomes fear; by the way in which we 'often enumerate and imagine the common dangers of life, and think upon the manner in which they can best be avoided and overcome by presence of mind and courage' (p.84). Neu goes on further to suggest that 'adequate ideas and their various associated emotions all lead to pleasure in the contemplation of adequate ideas and our power; and this pleasure is part of what makes the associated emotion active.' (p.98).

The parallels between Spinoza's theory of emotion, and the mechanisms of the ACT model of chapter six are remarkable. In both cases, emotions are part of the self regulating nature of the individual. In both cases, it is obtaining of an adequate predictive schema that quiets the negative affect, and characterises positive affect. Furthermore, the other aspects of Spinoza's philosophy of mind, makes it certain that accompanying a change in emotion will be a change in action tendencies, and the monitoring of the

environment. (This last point is not straight forward, but derives from the fact that causal beliefs are contained within an emotion and will give rise to the illusion of willed action. The causes contained within the emotion thus will determine the way in which the person monitors the environment).

The modern day legacy of the Spinozist theory of emotion is to be found in Action Theory accounts of emotion. Boesch (1984) provides an account of the development of affective schemata in action theory terms. Boesch defines feelings and emotions as 'secondary actions' and states that these function to regulate the primary or goal-directed actions. The Action Theory account of emotion differs somewhat from the ACT model but it does have an important parallel. The emotional schemata that action theory postulates gives rise to general goal concepts (associated with object valences) termed fantasms, and the individual tries to transform these into concrete goal-specific fantasies. Thus, in parallel with the ACT model, emotion and planning are linked, with the power of goal completion as a source of positive affect.

The Value of the ACT Model

The ACT model of chapter six was developed without knowledge of Spinoza's theory of emotion, or of the Action Theory account of emotion. It is gratifying that the degree of parallelism between it and these other models is high. At the very least it means that it is congruent with the observational sets which gave rise to the earlier models. But, in order to be of much value, a model should not only be able to account for the subsets of data that it was

designed for, it should be intelligible to people wanting to extend and use the model. This is especially important one would argue in the case of emotion theory. For instance, even if the Schachter account of emotion was true, it is likely that a therapist would have to provide a client a different account of change in emotional states than a relabelling. To be therapeutically most useful, a model must explain the phenomenology of affect convincingly to the extent that a client is willing to adopt the strategies suggested by the model. The extent to which one model will be preferred over another model will thus be determined partially by the social applicability of the alternative models.

The present model preserves a number of insights into emotion that philosophers and phenomenologists have made. Strongman (1978) reviews a number of theories of emotion from philosophers and phenomenologists, and we find that the ACT model of chapter six is compatible and explanative of a number of the essential characteristics of emotion noted by these theorists. Peters (1970) view that negative emotions in particular are passive, corresponds to the fact that when a viable coping plan is obtained in the ACT model, negative affect is allayed. On the other hand, the coincidence of emotion and plan formation corresponds to the firm linkage between emotion and action put forward by Louch (1966),

Finally, the present model predicts that with emotion, there is a transformation of the world as suggested by Sartre, (1971); the ACT model explicitly suggests that the solutions for coping with emotion provoking situations have monitoring results that will affect the way in which the environment

is processed and hence consciousness. The ACT model thus provides some mechanisms that explain the nature of phenomenal experience under emotion. This must be regarded as a strength of the model.

A Reservation about the ACT model

There is a reservation that must be made about the ACT model, and that is that it does little to explain the way that the self schema is involved in emotion and personality. In chapter one, it was concluded that any complete theory of emotion would have to explain how affect was related to the operation of the self-schema. The ACT model of chapter six does not develop an account of the way in which the self-schema is involved in the setting of goals, and the choice of the means of solving and monitoring the plans to achieve these goals. The relationship between the ACT model and personality through the assembly of problem solving heuristics lacks the connection of a statement of how agency and self is involved in these processes. No expansion of the ACT model to solve that problem is proposed here, but it is noted that there is a need for such an expansion.

Concluding Comments: Directions for Cognitive Psychology

In conclusion, this thesis by following a cognitive approach as it aired the issues of emotion and personality theory, has highlighted that affect is a much neglected area of study by mainstream cognitive psychologists. It is hoped that in the future more cognitive psychologists will use their research methods and theories to explore the puzzle of the relationship between emotion and cognition, discussed

in this thesis. It is an emotional world, and if we hope to understand people's relationship to their world, we must recognise that it becomes an emotional world through the way that people process the world. There is no deviation of course involved in this recognition for cognitive psychologists; the fundamental categories of cognition are emotional. It is time for cognitive science to study its fundamental categories. In doing so, it might be laying the essential foundations of a 'concrete' theory of personality.

NOTES

Note 1 : STRONGMAN , K.T., & RUSSELL, P.N. Saliance of emotion in recall. Unpublished manuscript: Department of Psychology, University of Canterbury, 1983.

Note 2 : Versa Computing Inc, Newbury Park, California 91320. (887 Conestoga Circle, California.) Versa Writer Manual.

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ADDENDUM

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Arousal-induced self-awareness: An artifactual relationship? Journal of Personality and Social Psychology, 1983, 44, 285-289.

Appendix 1.

Example stimulus blocks and the words used in the Warren task experiments (Chapter four).

Contents

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Stimulus words used in Experiments	367

LIST 2 : BLOCK 1 : EXPERIMENT 1 & 2

CONDITIONS AND STIMULUS WORDS

TARGET	PRIME/DISTRACTOR	VAL	EMOT	CAT	ABST
NOTE	WORRY	N	N	8	A
FRIEND	XXXXX	X	E	3	C
PEACH	XXXXX	X	E	3	C
HURT	MINUTE	N	E	2	C
LETTER	APPLE	SE	N	8	A
HOUR	MINUTE	V	N	7	A
GLAD	SUN	N	E	3	A
MAD	MEAN	V	E	2	A
STORM	YEAR	SE	N	5	C
BANANA	STORY	SE	N	6	C
ACCIDENT	PAIN	V	E	4	C
CLOUDS	XXXXX	X	N	5	C
FIGHT	DELIGHT	SE	E	2	C
JOY	SMILE	V	E	3	A
BERRY	GRAPE	V	N	6	C
SCREAM	WORRY	SE	E	1	C
NOVEL	ARTICLE	V	N	8	A
MIST	SNOW	V	N	5	C
PEAR	HAPPY	N	N	6	C
SAD	ARTICLE	N	E	4	A
TERROR	DARK	V	E	1	A
TEMPER	XXXXX	X	E	2	A
FUN	FAIL	SE	E	3	C
SECOND	DARK	N	N	7	A
HUNGER	RAGE	SE	E	4	C
RAIN	ENEMY	N	N	5	C
WEEK	XXXXX	X	N	7	A
NOISE	GRAPE	N	E	1	C
POEM	XXXXX	X	N	8	A
DISTRESS	XXXXX	X	E	4	A
FEAR	XXXXX	X	E	1	A
CENTURY	SUN	SE	N	7	A

BLOCK 1 : EXPERIMENT 3

CONDITIONS AND STIMULUS WORDS

DISTRACTOR 1	DISTRACTOR 2	CAT1	CAT2	COL
HUNGER	PEAR	4	6	N
STORY	RAGE	8	2	N
SNOW	FAIL	5	1	E
WEEK	FIGHT	7	2	N
GRAPE	WORRY	6	4	E
NOISE	PEACH	1	6	E
MONTH	SMILE	7	3	N
RAIN	GLAD	5	3	N
TEMPER	POEM	2	8	N
BOOK	LOSS	8	4	N
CENTURY	ACCIDENT	7	4	E
ANGER	YEAR	2	7	E
FRIEND	BERRY	3	6	N
BOOK	DELIGHT	8	3	E
ENEMY	PLUM	2	6	N
SAD	NOVEL	4	8	E
HURT	BANANA	2	6	E
CLOUDS	DISTRESS	5	4	N
DARK	ARTICLE	1	8	N
SUN	MEAN	5	2	E
LETTER	FEAR	8	1	E
HAPPY	LEMON	3	6	N
PAIN	MINUTE	4	7	E
MIST	MAD	5	2	E
TERROR	SECOND	1	7	N
DAY	DREAD	7	1	N
JOY	NOTE	3	8	E
STORM	SCREAM	5	1	N
WIN	WIND	3	5	E
DESPAIR	PLAY	4	8	N
HOOR	FUN	7	3	E
SCARED	APPLE	1	6	E

Stimulus words used in the Warren task experiments of Chapter four. (Numbers refer to frequency count)

A. List 1 words

CATEGORY =	FEAR		ANGER		JOY		DISTRESS	
	Scared	37	Rage	49	Delight	A	Despair	38
	Dread	45	Anger	A	Happy	AA	Worry	A
	Dark	AA	Mean	AA	Smile	AA	Loss	AA
	Fail	AA	Enemy	AA	Win	AA	Pain	AA
CATEGORY =	WEATHER		FRUIT		TIME		LITERATURE	
	Snow	AA	Apple	A	Minute	AA	Play	AA
	Wine	AA	Lemon	27	Month	AA	Article	AA
	Sun	AA	Grape	34	Year	AA	Book	AA
	Hot	AA	Plum	23	Day	AA	Story	AA

B. List 2 words

CATEGORY =	FEAR		ANGER		JOY		DISTRESS	
	Fear	AA	Temper	39	Joy	AA	Distress	38
	Terror	48	Mad	A	Glad	AA	Sad	A
	Scream	47	Hurt	AA	Friend	AA	Hunger	37
	Noise	A	Fight	AA	Fun	A	Accident	A
CATEGORY =	WEATHER		FRUIT		TIME		LITERATURE	
	Rain	AA	Pear	21	Hour	AA	Poem	A
	Clouds	AA	Berry	29	Century	AA	Note	AA
	Mist	29	Banana	13	Second	AA	Letter	AA
	Storm	AA	Peach	29	Week	AA	Novel	39

APPENDIX 2

This page: Emotion scales administered after the
Warren task Experiments I & II.

Next page: Emotion scales administered after Warren
task Experiment III.

Emotion state scales

DIRECTIONS: A number of emotion words that people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the emotion word to indicate how you feel right now.

There are no right or wrong answers. Do not spend too much time on any one emotion word but give the answer that seems best to describe your feelings as you recall them.

	Not at all		Moderately		Extremely	
<hr/>						
1. repentant	0	1	2	3	4	5
2. delighted	0	1	2	3	4	5
3. downhearted	0	1	2	3	4	5
4. surprised	0	1	2	3	4	5
5. sheepish	0	1	2	3	4	5
6. attentive	0	1	2	3	4	5
7. scared	0	1	2	3	4	5
8. enraged	0	1	2	3	4	5
9. happy	0	1	2	3	4	5
10. concentrating	0	1	2	3	4	5
11. amazed	0	1	2	3	4	5
12. fearful	0	1	2	3	4	5
13. angry	0	1	2	3	4	5
14. sad	0	1	2	3	4	5
15. guilty	0	1	2	3	4	5
16. bashful	0	1	2	3	4	5
17. joyful	0	1	2	3	4	5
18. blameworthy	0	1	2	3	4	5
19. astonished	0	1	2	3	4	5
20. alert	0	1	2	3	4	5
21. mad	0	1	2	3	4	5
22. discouraged	0	1	2	3	4	5
23. shy	0	1	2	3	4	5
24. afraid	0	1	2	3	4	5

Emotion trait scales

DIRECTIONS: A number of emotion words that people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the emotion word to indicate how you feel on average during a typical moment in a typical day.

There are no right or wrong answers. Do not spend too much time on any one emotion word but give the answer that seems best to characterise your typical feelings as you recall them.

	Not at all		Moderately			Extremely	
	0	1	2	3	4	5	6
1. repentant	0	1	2	3	4	5	6
2. delighted	0	1	2	3	4	5	6
3. downhearted	0	1	2	3	4	5	6
4. surprised	0	1	2	3	4	5	6
5. sheepish	0	1	2	3	4	5	6
6. attentive	0	1	2	3	4	5	6
7. scared	0	1	2	3	4	5	6
8. enraged	0	1	2	3	4	5	6
9. happy	0	1	2	3	4	5	6
10. concentrating	0	1	2	3	4	5	6
11. amazed	0	1	2	3	4	5	6
12. fearful	0	1	2	3	4	5	6
13. angry	0	1	2	3	4	5	6
14. sad	0	1	2	3	4	5	6
15. guilty	0	1	2	3	4	5	6
16. bashful	0	1	2	3	4	5	6
17. joyful	0	1	2	3	4	5	6
18. blameworthy	0	1	2	3	4	5	6
19. astonished	0	1	2	3	4	5	6
20. alert	0	1	2	3	4	5	6
21. mad	0	1	2	3	4	5	6
22. discouraged	0	1	2	3	4	5	6
23. shy	0	1	2	3	4	5	6
24. afraid	0	1	2	3	4	5	6

APPENDIX 3

This page: Operating program

Next 3 pages: Program for the Warren experiments
discussed in Chapter four.

```

10  REM      WARREN EXPT
20  REM      =====>=====
30  REM
40  REM      BY:  G. RITCHIE
50  REM
60  REM
70  REM      *****
80  REM      * SET LOMEM *
90  REM      *****
100 REM
110 PRINT CHR$(4)"BRUN LOMEM:"
    : & LOMEM: 24576
120 REM
130 REM      *****
140 REM      * LOAD TIMERS *
150 REM      *****
160 REM
170 PRINT CHR$(4);"BLOAD VTIME
    R"
180 REM
190 REM      *****
    **
200 REM      * LOAD CHARACTER FONT
    *
210 REM      *****
    **
220 REM
230 PRINT CHR$(4);"BLOAD SHAP,
    A$C00"
240 POKE 232,0
250 POKE 233,12
260 REM
270 REM      *****
280 REM      * RUN PROGRAM *
290 REM      *****
300 REM
310 PRINT CHR$(4);"RUN VOICEWA
    RREN"
320 END

```



```

10 REM *****
*****
50 REM THE WARREN TASK- AN EXPE
RIMENTAL
90 REM PROCEEDURE FOR THE INVES
TIGATION
130 REM OF SEMANTIC RELATIONS.
170 REM THIS IS A MODIFIED VERS
ION OF
210 REM THE WARREN (1972) PARID
IGM THAT
250 REM ALLOWS THE EXPERIMENTER
TO
290 REM INVESTIGATE THE ATTENTI
ON
330 REM CAPTURE CHARACTERISTICS
OF
370 REM THE STIMULUS ,IN ADDITI
ON TO
410 REM THE SPEED THAT THE STIM
ULUS
450 REM ACCESSES A NAME CODE.
490 REM *****
530 REM * DECLARE VARIABLES *

570 REM *****

610 REM
650 DIM WRD$(50,4),C$(50,4),REAC
N(50),MIST$(50),OMIS$(50),B
L$(22),COL$(3)
690 REM
700 PRINT "INPUT THE FOLLOWING D
ETAILS ABOUT"
705 PRINT "THE SUBJECT : NAME ,
SEX, AGE, CONDN"
710 INPUT SU$: HOME
730 REM *****
*
770 REM * READ IN WORDS
*
810 REM *****
*
815 INPUT "VOICE TIMERS (Y OR N)
";VT$
816 IF LEFT$(VT$,1) = "Y" THEN
VT = 1: GOTO 820
818 IF LEFT$(VT$,1) < > "N" THEN
815
820 INPUT "INPUT THE NUMBER OF B
LOCKS ";BL$(1)
830 INPUT "INPUT THE STIMULI PER
BLOCK ";BL$(2)
840 PRINT "INPUT THE ORDER THAT
THE BLOCKS WILL"
850 PRINT "BE APPEARING": PRINT

860 FOR IN = 1 TO BL$(1)
870 PRINT "SEQUENCE ";IN;". ";
880 INPUT "BLOCK ";BL$(2 + IN)
885 NEXT
890 HOME :BL$(0) = 1
930 PRINT CHR$(7)
970 INPUT "ENTER INPUT FILE NAME
:";F$
990 GOTO 1490
1000 POKE 216,0: INPUT "ENTER IN
PUT FILE NAME :";F$
1010 PRINT CHR$(4);"OPEN";F$
1050 PRINT CHR$(4);"READ";F$
1130 IF BL$(IN + 2) = 1 THEN INPUT
NUMB
1140 P = (BL$(IN + 2) - 1) * BL$(
2) * 4 + 1
1141 IF BL$(IN + 2) = 1 THEN P =
0
1143 P$ = STR$(P)
1145 R$ = "R" + P$
1147 Q$ = "POSITION " + F$ + "," +
R$

1150 PRINT CHR$(4);Q$
1160 PRINT CHR$(4);"READ";F$
1170 POKE 216,0
1210 FOR I = 1 TO BL$(2)
1250 FOR K = 1 TO 4
1290 INPUT WRD$(I,K),C$(I,K)
1330 NEXT K
1370 NEXT I
1410 PRINT CHR$(4);"CLOSE";F$
1430 RETURN
1450 REM
1490 REM *****

1530 REM * OUTPUT FILE NAME *

1570 REM *****

1610 REM
1650 HOME
1690 PRINT CHR$(7);
1730 INPUT "ENTER OUTPUT FILE NA
ME:";G1$
1735 PRINT : PRINT CHR$(7): INVERSE
: FLASH
1740 PRINT "NOW INSERT THE DISK
THAT YOU"
1742 PRINT "WANT YOUR DATA ON": NORMAL
1744 PRINT : PRINT "IF YOU WANT
A RANDOM FIXATION "
1746 INPUT "PRESS R, ELSE N ";R$
1747 GOTO 2010
1748 HOME
1800 REM **CREATE RES FILES**
1810 PRINT CHR$(4)
1820 PRINT CHR$(4);"OPEN";G1$
1830 PRINT CHR$(4);"WRITE";G1$

1835 PRINT SU$
1840 PRINT NUMB
1843 FOR I = 1 TO BL$(1) + 2
1845 PRINT BL$(I)
1847 NEXT
1850 PRINT CHR$(4);"CLOSE";G1$

1900 RETURN
2010 POKE 216,0
2050 REM ** EMOTION CONDITION**
2090 HOME
2130 PRINT "INPUT THE KIND OF EM
OTION CONDITION "
2140 PRINT "THAT YOU PREFER."
2150 PRINT "(HAPPY,ANGRY,FEARFUL
,DISTRESSED,NON)"
2160 INPUT EM$
2190 PL$ = "HIGHER":NE$ = "MUCH"
2200 IF LEFT$(EM$,1) = "N" THEN
PL$ = "WORSE":NE$ = "LITTLE"

2330 REM
2370 REM *****
2410 REM *GET DELAY TIME *
2450 REM *****
2490 REM
2570 HOME
2610 INPUT "ENTER DELAY TIME (MS
) BETWEEN SUBJECTS RESPONSE
AND THE ONSET OF THE NEXT ST
IMULUS";DLAY
2650 IF (DLAY > 60000) THEN 2570

2690 HOME
2730 PRINT "ENTER THE LENGTH OFT
IME(MS) THAT THE"
2770 PRINT "CUING TO BE REMEMBER
ED STIMULUS "
2810 PRINT "SHOULD REMAIN ON THE
SCREEN"
2850 INPUT SP

```

```

2890 PRINT "IF THERE IS NO PRECU
E FED IN WITH THE "
2895 PRINT "DATA FILE ,INDICATE
WHETHER YOU WANT "
2900 INPUT " A FIXATION STIMULUS
BY TYPING X ";HA$
2930 REM **THIS PLACE RESERVED
FOR DELAYTIMER OPTION**
2970 REM *****
3010 REM *OUTPUT INSTRUCTIONS*
3050 REM *****
3090 REM
3130 HOME
3170 PRINT "INSTRUCTIONS"
3210 GET A$
3220 IF LEFT$(HA$,1) = "X" THEN
HA = 2
3230 IF HA$ = "" THEN HA = 1
3250 REM
3290 REM *****
3330 REM * START LOOP *
3370 REM *****
3410 REM
3450 POKE - 16302,0
3490 HGR
3530 SCALE= 1
3570 ROT= 0
3650 FOR IN = 1 TO BL$(1)
3670 X = FRE (0)
3690 BL$(0) = (BL$(2 + IN) - 1) *
BL$(2) + 1
3700 GOSUB 20000
3710 GOSUB 1010
3712 GET A$
3714 IF A$ > < "D" THEN 3712
3720 IF IN = 1 THEN GOSUB 1800
3730 FOR I = 1 TO BL$(2)
3750 IF HA = 2 THEN WRD$(I,1) =
"XXXXX"
3770 HGR : HGR2
3810 HCOLOR= 3
3850 COL$(1) = INT ( RND (37) *
3 + 1)
3870 IF C$(I,2) = "" THEN 3930
3890 IF ASC (C$(I,3)) = ASC (C
$(I,2)) THEN GOTO 4090
3930 COL$(2) = INT ( RND (37) *
2 + 1)
3970 SC = COL$(1) + COL$(2)
4010 IF SC > 3 THEN SC = SC - 3
4050 COL$(2) = SC: GOTO 4110
4090 COL$(2) = COL$(1)
4110 IF C$(I,4) = "" THEN COL$(3
) = 1: GOTO 4460
4130 IF ASC (C$(I,4)) = ASC (C
$(I,3)) THEN GOTO 4410
4150 IF C$(I,4) = "" THEN COL$(3
) = 1: GOTO 4460
4170 IF ASC (C$(I,4)) = ASC (C
$(I,2)) THEN GOTO 4450
4210 COL$(3) = INT ( RND (37) *
1 + 1)
4250 SC = COL$(3) + COL$(2)
4290 IF SC > 3 THEN SC = SC - 3
4330 IF SC = COL$(1) THEN SC = S
C + 1: GOTO 4290
4340 IF SC = COL$(2) THEN SC = S
C + 1: GOTO 4290
4350 COL$(3) = SC
4370 GOTO 4460
4410 COL$(3) = COL$(2): GOTO 4460

```

```

4450 COL$(3) = COL$(1)
4460 FOR K = 1 TO 3
4463 IF C$(I,K + 1) = "" THEN CO
L$(K) = 0
4465 ON COL$(K) + 1 GOTO 4478,44
70,4474,4476
4470 COL$(K) = 1: GOTO 4480
4474 COL$(K) = .5: GOTO 4480
4476 COL$(K) = 6: GOTO 4480
4478 COL$(K) = 0: HD = 0
4480 NEXT
4490 K = 1
4495 COL$(0) = 3
4500 P1 = 0: P2 = 0
4530 POKE 230,32
4570 CALL 62450
4600 IF WRD$(I,1) = "." THEN COL$
(0) = 0
4610 GOSUB 5930
4650 TIME = DLAY
4690 GOSUB 5130
4730 POKE - 16300,0
4770 REM
4810 REM *****
4850 REM * DELAY *
4890 REM *****
4930 REM
4970 TIME = SP
5010 GOSUB 5130
5050 TIME = DLAY
5090 GOTO 5370
5130 POKE 6,0
5170 POKE 819, INT (TIME / 256)
5210 POKE 818, TIME - INT (TIME /
256) * 256
5250 CALL 820
5290 RETURN
5330 REM
5370 CALL 62450
5410 GOSUB 5130
5450 REM *****
5490 REM * WRITE WORDS *
5530 REM *****
5570 REM
5610 POKE 230,64
5650 CALL 62450
5690 POKE - 16302,0
5700 P1 = 0: P2 = 0
5710 IF R$ = "R" THEN P1 = INT
( RND (34) * 90 - 45): P2 = INT
( RND (35) * 90 - 45)
5730 FOR K = 2 TO 4
5770 P = K
5810 GOSUB 5890
5850 GOTO 6410
5890 HCOLOR= COL$(K - 1)
5930 C2 = 0
5970 CA = 0
5990 IF COL$(K - 1) = 0 THEN 637
0
6010 IF K = 1 THEN P = 3
6050 ST = INT ((28 - LEN (WRD$
(I,K))) / 2) - 1
6090 FOR J = 1 TO LEN (WRD$(I,K
))
6130 LTR = ASC ( LEFT$ ( RIGHT$
(WRD$(I,K), LEN (WRD$(I,K)) +
1 - J),1))
6170 IF (LTR > = 65) AND (LTR <
= 90) AND (CA = 0) AND (C2 =
0) THEN LTR = LTR - 64
6210 CA = 0
6250 IF LTR > 26 THEN 6330
6290 DRAW LTR AT ST * 5 + J * 15
+ P1,90 + 20 * (P - 3) + P2
6330 NEXT J
6370 RETURN
6410 NEXT K

```

```

6450 REM
6490 REM *****
6530 REM * SET UP REACT TIMER*
6570 REM *****
6610 REM
6650 POKE 6,0
6690 POKE 818,0
6730 POKE 819,0
6770 REM
6810 REM *****

6850 REM * DISPLAY WORDS *

6890 REM *****

6930 REM
6970 POKE - 16299,0
6990 POKE - 16368,0
7010 REM
7050 REM *****
7090 REM * START TIMER *
7130 REM *****
7170 REM
7210 CALL 768
7250 REACTN(I) = PEEK (819) * 25
      6 + PEEK (818)
7290 REM *****
7330 REM * RECORD REACTION *
7370 REM * TIME *
7410 REM *****
7420 IF VT < > 1 THEN 7490
7430 CALL 62450: HGR : TEXT : HOME

7432 IF HA > 0 THEN GOTO 7450
7435 VTAB 12: HTAB 12
7440 PRINT "CUE WORD?"
7450 VTAB 21: PRINT "PRESS ANY K
      EY TO CONTINUE"
7455 GET RS$
7460 VTAB 1: HTAB 1: HOME
7470 GOTO 7888
7490 GET RS$
7570 CALL 62450
7610 HGR
7650 IF VAL ( LEFT$ (RS$,1)) <
      > VAL ( LEFT$ (C$(I,3),1))
      THEN MIST$(I) = 1
7670 IF HA > 0 THEN 7855
7690 TEXT : HOME : PRINT "NOW TY
      PE IN WHAT THE WHITE CUING W
      ORD"
7730 PRINT "THAT YOU HAD TO REME
      MBER WAS ?": PRINT : PRINT
7770 INPUT " ";C$(I,2): PRINT
      : PRINT
7810 PRINT "SATISFIED WITH THE S
      PELLING? (Y/N) ": GET Y$
7850 IF ASC (Y$) < > 89 THEN HOME
      : GOTO 7690
7855 HOME : HTAB 5: VTAB 6: PRINT
      CHR$ (7)
7860 IF VAL ( LEFT$ (RS$,1)) =
      COL$(2) GOTO 7870
7861 MIST$(I) = VAL ( LEFT$ (RS$
      ,1))
7863 : HTAB 5: VTAB 6: PRINT CHR$
      (7)
7865 PRINT "WRONG COLOUR BE MORE
      CAREFUL"
7870 IF HA > 0 THEN GOTO 7888
7875 IF LEFT$ (C$(I,2), LEN (WR
      D$(I,1))) = LEFT$ (WRD$(I,1
      ), LEN (WRD$(I,1))) THEN 788
      8
7878 HTAB 5: VTAB 12:OMMIS$(I) =
      1
7880 PRINT "YOU HAVE MADE A MIST
      AKE IN YOUR "
7881 PRINT "IN YOUR RECALL OF TH
      E FIRST WORD"
7882 INVERSE : PRINT "TRY HARDER
      TO REMEMBER ": PRINT "THE N
      EXT WORD": FLASH
7888 FOR K = 1 TO 1000: NEXT
7889 NORMAL
7890 REM * END OF LOOP
      *

7930 REM *****
**
7970 NEXT I
7990 GOSUB 8210
8010 NEXT IN
8020 GOTO 8570
8050 REM
8090 REM *****
**
8130 REM * WRITE RESULTS
      *
8170 REM *****
**
8210 REM
8250 HOME
8270 PRINT CHR$ (4)
8290 PRINT CHR$ (4);"APPEND";G1
      $
8330 PRINT CHR$ (4);"WRITE ";G1
      $
8410 FOR I = 1 TO BL$(2)
8450 PRINT C$(I,1);",";REACTN(I)

8490 NEXT I
8491 PRINT CHR$ (4);"CLOSE";G1$

8550 RETURN
8570 TEXT
8610 HOME
8650 PRINT "EXPERIMENT ENDS"
8690 END
9491 PRINT CHR$ (4);"CLOSE";G1$

20000 REM ** SUBROUTINE FOR EMOT
      ION ***
20020 TEXT
20050 PRINT "THIS IS A BREAK BET
      WEEN CONDITIONS.": PRINT
20100 PRINT "YOUR TASK IS TO TEL
      L A "; INVERSE : PRINT EM$:
      NORMAL : PRINT
20150 PRINT "EMOTIONAL STORY ABO
      UT THE PICTURE": PRINT
20200 PRINT "THAT THE EXPERIMENT
      ER WILL SHOW YOU.": PRINT
20250 PRINT "PLEASE TRY TO SHOW
      AS ";NE$;" EMOTIONAL ": PRINT

20300 PRINT "INVOLVEMENT AS POSS
      IBLE IN THE STORY": PRINT
20320 IF LEFT$ (EM$,1) = "N" THEN
      20420
20350 PRINT "-JUST LIKE YOU WERE
      ONE OF THE ": PRINT
20400 PRINT "CHARACTERS.": PRINT
      : GOTO 20450
20420 PRINT "-JUST AS MATTER OF
      FACT AS YOU CAN ": PRINT
20430 PRINT "MAKE IT.": PRINT
20450 PRINT "THE EXPERIMENTER WI
      LL RECORD YOUR STORY": PRINT

20500 PRINT " , AND SCORE IT ";P
      L$ " FOR THE DEGREE": PRINT
20520 IF LEFT$ (EM$,1) = "N" THEN
      ME$ = "": GOTO 20550
20530 ME$ = EM$
20550 PRINT "OF ";
20560 INVERSE : PRINT ;ME$;: NORMAL

20570 PRINT " EMOTIONAL INVOLVEM
      ENT THAT ": PRINT : PRINT "Y
      OU SHOW."
20580 GET A$: HOME : HGR : HGR2

20600 RETURN

```

APPENDIX 4.

This page: Operating program.

Next 2 pages: Program for the Treisman
 Experiments discussed in
 Chapter five.

```

10 REM      TREISMAN EXPT
20 REM      =====
30 REM
40 REM      BY: G. RITCHIE
50 REM
60 REM
70 REM      *****
80 REM      * SET LOMEM *
90 REM      *****
100 REM
110 PRINT  CHR$(4)"BRUN LOMEM:"
    : & LOMEM: 24576
120 REM
130 REM      *****
140 REM      * LOAD TIMERS *
150 REM      *****
160 REM
170 PRINT  CHR$(4);"BLOAD VTIME
    R"
180 REM
190 REM      *****
    **
200 REM      * LOAD CHARACTER FONT
    *
210 REM      *****
    **
220 REM
230 PRINT  CHR$(4);"BLOAD SHAP,
    A$C00"
240 POKE 232,0
250 POKE 233,12
260 REM
270 REM      *****
280 REM      * RUN PROGRAM *
290 REM      *****
300 REM
310 PRINT  CHR$(4);"RUN TREIS E
    XP"
320 END

```

```

10 ROT= 0: SCALE= 1
20 DIM DE(16,2),PA(26)
30 CU = 400:SU = - 16336:BT = 0
50 FOR I = 1 TO 4: READ CO(I),CO
  $(I): NEXT
60 DATA 1,"GREEN",2,"VIOLET",5,
  "ORANGE",6,"BLUE"
70 PRINT "FOR THE COURSE OF THIS
  EXPERIMENT YOU WILL BE TA
  XED OR RECEIVE BONUSES ON
  ABOUT 20% OF TRIALS"
80 PRINT : PRINT "NOW ROLL THE D
  ICE AND SEE WHETHER YOU WI
  LL BE TAXED, OR RECEIVE BONU
  SES."
90 PRINT : INPUT "TAXES OR BONUS
  ES? ";RT$
92 IF LEFT$(RT$,3) = "BON" THEN
  RT = 1: GOTO 100
94 IF LEFT$(RT$,3) = "TAX" THEN
  RT = - 1: GOTO 100
95 IF LEFT$(RT$,3) = "CON" THEN
  RT = 0: GOTO 100
96 GOTO 90
100 REM INPUT PHASE
110 INPUT "NAME OF INPUT FILE?
  ";IP$
120 INPUT "NAME OF OUTPUT FILE?
  ";OP$
130 PRINT CHR$(4);"OPEN ";OP$
140 PRINT CHR$(4);"CLOSE ";OP$

150 PRINT CHR$(4);"OPEN ";IP$
160 PRINT CHR$(4);"READ ";IP$
170 INPUT L
175 DIM PS$(L)
180 FOR I = 1 TO L
190 INPUT PS$(I)
200 NEXT
210 PRINT CHR$(4);"CLOSE ";IP$

220 R = 0
230 R = R + 1
235 S6$ = MID$(PS$(R),3,1)
240 S1$ = MID$(PS$(R),4,2)
245 S2$ = MID$(PS$(R),6,1)
250 REM TARGET STIMULUS
255 S1 = VAL(S1$)
256 S2 = VAL(S2$)
260 O1 = VAL(MID$(PS$(R),S1 +
  9,1))
270 S3 = VAL(MID$(PS$(R),7,1)
  )
275 S2 = VAL(MID$(PS$(R),6,1)
  )
300 REM STAKING PART OF THE PRO
  GRAM
310 HOME : VTAB 5: INVERSE : PRINT
  "YOUR TOTAL AMOUNT IS ";CU;"
  ": NORMAL
320 ST = VAL(MID$(PS$(R),8,2)
  )
330 VTAB 10: PRINT "DO YOU WANT
  TO BET THE HIGH AMOUNT OR
  THE LOW AMOUNT ON THIS TRIAL
  ."
340 VTAB 15: HTAB 10: PRINT "LOW
  =" ;ST + 10; TAB(20); "HIGH="
  ;ST + 20
345 VTAB 20: HTAB 5: PRINT "LOW(
  1) OR HIGH(2)?";: GET SC$
350 VTAB 23: SC = VAL(SC$)
355 IF SC < 1 THEN 360
356 IF SC < 3 THEN 380
360 HOME : FLASH : PRINT "INPUT
  ERROR TRY AGAIN.": NORMAL
365 GOTO 330
380 NORMAL : HOME

```

```

400 REM COLOUR CHOICE
410 VTAB 10: PRINT "WHICH OF THE
  FOLLOWING COLOURS ARE YOU
  GOING TO BET ON? "
420 PA(1) = INT(RND(97) * 2 +
  1)
440 PA(2) = 3 - PA(1)
450 VTAB 13: PRINT "(1) ";CO$(PA
  (1))
460 VTAB 15: PRINT "(2) ";CO$(PA
  (2))
470 VTAB 19: INPUT "WHICH DO YOU
  CHOOSE? ";CC
480 IF CC < 1 THEN 500
490 IF CC < 3 THEN 510
500 POKE 34,17: HOME : VTAB 22: FLASH
  : PRINT "INPUT ERROR TRY AGA
  IN.": NORMAL : POKE 34,0: GOTO
  470
510 REM SUCCESS OR OTHERWISE
520 TE = RND(97) + RND(97) +
  RND(97)
530 TE = 1 + INT(TE / 1.5)
535 IF CC = TE THEN CC$ = "W":WF =
  1: GOTO 550
540 CC$ = "L":WF = 0
550 HCOLOR= CO(PA(CC))
552 IF CC$ = "W" THEN C2 = CO(PA
  (CC)): GOTO 560
555 C2 = CO(PA(3 - CC))
560 HOME : HGR : HGR2 : POKE 230
  ,32
570 FOR I = 1 TO 10: HPLLOT 72,70
  + I TO 92,70 + I: NEXT
575 POKE - 16300,0
580 FOR I = 1 TO 1000: NEXT
590 HOME : HGR : HGR2 : CALL 624
  50
600 REM ROUTINE FOR DISPLAYING
602 POKE - 16300,0: POKE 230,64

603 HCOLOR= CO(PA(CC))
604 FOR I = 1 TO 10: HPLLOT 72,70
  + I TO 92,70 + I: NEXT
606 KF = 56
610 FOR I = 1 TO 8
620 OD = VAL(MID$(PS$(R),9 +
  I,1))
630 IF OD < = 0 THEN 700
640 HCOLOR= 3
670 DRAW OD AT ((I - 1 + INT(I
  / 5) - INT((I - 1 + INT
  (I / 5)) / 3) * 3) * KF + 13
  + C2 - 1),(INT((I - 1 + INT
  (I / 5)) / 3) * KF) + 18
700 DRAW S2 + 7 AT ((I - 1 + INT
  (I / 5) - INT((I - 1 + INT
  (I / 5)) / 3) * 3) * KF) + C
  2 - 1,(INT((I - 1 + INT(
  I / 5)) / 3) * KF)
710 NEXT I
720 XDRAW S2 + 7 AT ((S1 - 1 + INT
  (S1 / 5) - INT((S1 - 1 + INT
  (S1 / 5)) / 3) * 3) * KF) +
  C2 - 1,(INT((S1 - 1 + INT
  (S1 / 5)) / 3) * KF)
730 DRAW S3 + 7 AT ((S1 - 1 + INT
  (S1 / 5) - INT((S1 - 1 + INT
  (S1 / 5)) / 3) * 3) * KF) +
  C2 - 1,(INT((S1 - 1 + INT
  (S1 / 5)) / 3) * KF)
740 POKE - 16299,0
750 REM TIMER PART
760 POKE 6,0
770 POKE 818,0
780 POKE 819,0
790 CALL 768
792 FOR I = 1 TO 2000: NEXT
800 REACN = PEEK(818) * 256 + PEEK
  (819)

```

```

840 REM UPDATE STRING
850 RE$ = RIGHT$ ( STR$ (REACH +
    100000),5)
860 SC$ = STR$ (SC)
870 PS$(R) = RE$ + CC$ + SC$ + LEFT$
    (PS$(R),3)
900 REM REPORT THE RESULT
906 HGR2 : TEXT : HOME
908 IF RT = 0 THEN ST = ST + (SC
    - 1) * 10 + 10: GOTO 930
910 IF RND (97) > .2 THEN BO =
    0: GOTO 920
915 BO = INT ( RND (97) * 10 + 1
    ) * RT
920 ST = ST + (SC - 1) * 10 + 10
930 IF WF = 0 THEN 960
940 HTAB 10: PRINT "YOU ";: FLASH
    : PRINT "WON ";: NORMAL : PRINT
    ST
950 GOTO 965
960 HTAB 10: PRINT "YOU ";: FLASH
    : PRINT "LOST ";: NORMAL : PRINT
    ST
965 IF BO > 0 THEN INVERSE : VTAB
    15: HTAB 10: PRINT "BONUS =
    ";BO: NORMAL
970 IF BO < 0 THEN INVERSE : VTAB
    15: HTAB 10: PRINT "TAXES =
    "; - BO: NORMAL
975 BT = BT + BO
980 VTAB 20: PRINT TAB( 9);"PRE
    SS ANY KEY TO CONTINUE."
990 GET Q$
1000 WF = WF * 2 - 1
1010 CU = CU + ST * WF + BO
1060 IF ( INT (R / 40) - R / 40)
    < > 0 THEN 1100
1070 HOME : VTAB 5: PRINT "HAVE
    A SMALL REST"
1080 X = FRE (0)
1100 IF R < L THEN GOTO 230
1200 REM OUTPUT AT END OF EXPT
1210 GOSUB 2500
1220 LET D$ = CHR$ (4)
1240 PRINT D$;"OPEN ";OP$
1260 PRINT D$;"WRITE ";OP$
1280 PRINT R
1300 FOR I = 1 TO R
1320 PRINT PS$(I)
1340 NEXT
1350 PRINT W$(1),W$(2),W$(3),W$(
    4),W$(5),BT
1360 PRINT D$;"CLOSE ";OP$
1365 PRINT : PRINT "YOUR AMOUNT
    IS ";CU
1370 END

```

```

2000 REM COLOUR TARGET ROUTINE
2050 XDRAW S3 AT ((S1 - 1 - INT
    ((S1 - 1) / 4) * 4) * 3 + INT
    (S2 - 1 - INT ((S2 - 1) / 2
    ) * 2)) * KF,( INT ((S1 - 1)
    / 4) * 3.3 + INT ((S2 - 1)
    / 2) * 1.25) * KF
2055 IF CC$ = "W" THEN C2 = CO(P
    A(CC)):C1 = CO(PA(CC)): GOTO
    2068
2060 C2 = CO(PA(3 - CC)):C1 = CO(
    PA(CC))
2068 HCOLOR= C1
2070 DRAW S3 AT 240,( INT ((S1 -
    1) / 4) * 3.3 + INT ((S2 -
    1) / 2) * 1.25) * KF
2073 HCOLOR= C2
2075 DRAW O1 AT ((S1 - 1 - INT
    ((S1 - 1) / 4) * 4) * 3 + INT
    (S2 - 1 - INT ((S2 - 1) / 2
    ) * 2)) * KF,( INT ((S1 - 1)
    / 4) * 3.3 + INT ((S2 - 1)
    / 2) * 1.25) * KF
2080 FOR I = 1 TO 1000: NEXT
2090 RETURN
2500 HOME : VTAB 7: PRINT "ON A
    SEVEN POINT SCALE AS SHOWN,
    RATE YOUR FEELINGS ON THE
    CATEGORIES THAT THE FOLLO
    WING WORD TRIPLES COME FROM.
    "
2510 READ W$(1),W$(2),W$(3),W$(4
    ),W$(5)
2515 DATA "DELIGHTED,HAPPY,JOYF
    UL","DOWNHEARTED,SAD,DISCOUR
    AGED","ENRAGED,ANGRY,IRRITAT
    ED","ANXIOUS,TENSE,NERVOUS",
    "SCARED,FEARFUL,AFRAID"
2516 POKE 34,12
2520 FOR I = 1 TO 5
2530 HOME
2540 VTAB 13: HTAB 6: PRINT W$(I
    )
2550 VTAB 17: PRINT "NOT AT ALL"
    ; TAB( 25);"VERY STRONGLY"
2559 VTAB 20
2560 FOR K = 1 TO 39
2580 IF INT (K / 5) - K / 5 = 0
    THEN PRINT K / 5;; GOTO 26
    20
2600 PRINT " ";
2620 NEXT
2622 PRINT
2625 VTAB 22: INPUT "HOW WELL DO
    ES THIS CATEGORY APPLY? ";W$(
    I)
2640 NEXT
2645 POKE 34,0
2660 RETURN

```